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# ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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No. 1

## THE INTRAMUSCULAR ADMINISTRATION OF SODIUM CITRATE A NEW METHOD FOR THE CONTROL OF BLEEDING

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UPON the clinical application of the anticoagulating action of sodium citrate to blood transfusion, in 1915, there immediately arose the question of the effect of sodium citrate on the coagulability of the recipient's blood. Would the introduction of sodium citrate, recognized as an anticoagulant, result in a suspension of coagulation in the recipient? That this did not occur was soon established; in fact, a transient shortening of the coagulation time in the recipient, with a subsequent return to the previous level, was found to follow the transfusion of citrated blood. In an effort to seek an explanation for this paradoxical action, some experiments were begun by Neuhof in 1916 and again taken up in 1919 by both authors.

The experiments, consisting in the intravenous injection of solutions of sodium citrate, were performed on dogs under ether anaesthesia. They will be detailed in another publication. In brief they established the following hitherto undescribed results of the administration of sodium citrate: 1. The coagulation time is tremendously shortened within a few minutes of the introduction of non-toxic doses of sodium citrate, and this shortened coagulation time may be sustained for one or more days. 2. The bleeding time is likewise shortened so that, after citrate injection, a large vessel can be incised with prompt coagulation about the wound in the vessel. 3. Coincident with the shortened coagulation time the color of the venous blood is altered to a light arterial tint. 4. There is no fixed toxic or lethal dose of sodium citrate per kilogram of body weight, toxicity depending to a remarkable degree upon the rate of introduction of the citrate solution. 5. A toxic or lethal dose is characterized by a swing from the state of shortened coagulation time to one of suspended coagulation (incoagulability of the blood). We have therefore demonstrated that the pharmacological action of sodium citrate is not the universally accepted one of anticoagulation. On the contrary, intravenous administration of the drug shortens coagulation time. Only an

excess dose for a given bulk of blood will result in a suspension of coagulation. The latter phenomenon, universally used in the laboratory, led to the sodium citrate method of blood transfusion. It was this effect of an excess dose that overshadowed the ordinary pharmacological action of sodium citrate.

Few and incomplete observations have been made on the effect of the intravenous administration of sodium citrate in the human being. Weil<sup>1</sup> reported the effect of five grams of a twenty per cent. solution given to an adult. The coagulation time was shortened by half; no other data were given. In a case of hæmophilia described by Ottenberg<sup>2</sup> a minute dose (six-tenths of a gram) was followed by a marked drop in coagulation time with a subsequent prolongation of coagulation time as noted forty-eight hours later. Kinsella and Brown<sup>3</sup> reported an attempt to control the hemorrhagic manifestations in the lungs in influenza by the intravenous introduction of sodium citrate in one-gram doses and described effects on coagulation time in five patients. From none of these reports can one gain any idea of the duration of the changed coagulation time following citrate injections except in the case of hæmophilia. In all, with the single exception of Weil's case, very small doses were employed. We have been unable to find observations in the literature on the possible effects of large doses of sodium citrate on bleeding.

Our clinical studies, based on the experimental observations we have made, were begun about two and a half years ago. Sodium citrate has been administered by one route or another in about 500 cases and this report is based on observations made upon these patients. Small doses were at first employed. The effects from these being transient and uncertain, progressively increasing doses were administered in varying concentrations until the dosage for the desired action on coagulation and bleeding time was determined.

*Preparation and Concentration of the Solution.*—The solution is prepared by dissolving U.S.P. sodium citrate in distilled water, filtering if necessary. It is then sterilized in an autoclave. Unless clear the solution should not be used. We now employ a thirty per cent. solution. As a result of experimentation with various doses we have established a dose of nine grams for adults (thirty c.c. of the thirty per cent. solution) as the optimal dose for intramuscular use, six grams for intravenous introduction. The dose for infants and children is proportionate to the age and weight.

*Intravenous Administration.*—The results were reported in an earlier publication.<sup>4</sup> In a series of two hundred cases no untoward effects were noted when the sodium citrate solution was slowly introduced with the technic we employed. The effects on coagulation and bleeding time, to be noted below, were regularly obtained. We emphasized the necessity for the slow and intermittent introduction of the drug, pointing to the dangers of its rapid administration as noted in our animal experiments. A fatality in another's hands ensued in a case in which this precaution was not observed. This led us to investigate other methods of administration of sodium citrate



in an effort to determine if the desired effect could be obtained without the danger inherent in a careless intravenous injection of the drug.

Some interesting results followed the *oral* and *rectal* administration of very large doses of sodium citrate in a few cases, but these will not be reported here. The effects of the drug given by these routes proved too slow and uncertain for ordinary use. *Subcutaneously* given the effect of sodium citrate was very similar to that of the intravenous method. Marked local infiltration and pain at the site of injection occurred frequently, however, and the subcutaneous use of the drug had to be abandoned for this reason.

*Intramuscular Administration.*—This method has proven satisfactory and free from danger. The results obtained closely parallel those after intravenous injection. The method is of course simpler and the precaution of slow administration is unnecessary. The intramuscular method has therefore superseded the intravenous and other methods and is the only one we have employed in the last 200 cases. We would reserve the intravenous method for cases in which very prompt action is desired. The injection is given into the gluteal muscles. The introduction of thirty c.c. of a thirty per cent. solution of sodium citrate into one buttock was found to be very painful and weaker concentrations were tried without much improvement in this respect. Upon dividing the dose, fifteen c.c. in each buttock, the injection was not so painful, yet left much to be desired. We then found that a preliminary injection of novocaine before the introduction of the sodium citrate solution renders the method much less painful. The technic we now employ is as follows: Two four-inch needles are used, one for each buttock. With the needles inserted directly into the gluteal muscles three to four c.c. of a one per cent. solution of novocaine are introduced into each. Full time is allowed for the novocaine to act; that is, three or four minutes. The thirty per cent. sodium citrate solution is now injected, fifteen c.c. into each buttock. This method is not painless, but the discomfort is usually transient. There is no late infiltration. Two infections followed in the series of about 200 cases, but these may be attributed to errors in asepsis.

*The Effects of the Administration of Sodium Citrate. Changes in Coagulation Time.*—A typical curve after a dose of six grams, given *intravenously* in a patient having a coagulation time of ten minutes, may be described as follows: Five minutes after the injection the coagulation time drops to seven minutes, ten minutes later it reaches five minutes, in one-half hour the coagulation time is between two and three minutes. The peak is reached some forty minutes after the injection, and is sustained in the neighborhood of a two-minute coagulation time for an additional hour. The return to normal then begins, but this is much more gradual than the rapid drop after injection. In six hours the coagulation time reaches five minutes. Twelve hours after the injection it is still about seven minutes. The return to normal occurs after a variable time; in most instances the normal is reached in twenty-four hours, but occasionally not until forty-eight hours or longer after the administration of the drug. The reaction after *subcutaneous* administration is very

similar. The peak is not reached for an hour but is sustained for a much more prolonged period with a more gradual return to normal in from forty-eight to seventy-two hours. After *intramuscular* injections the results are almost identical with the subcutaneous method, the peak of the reaction occurring in about three-quarters of an hour, maintained for from one to three hours and usually returning to the normal within forty-eight hours. These curves are typical and figures closely approximating those we have given were obtained in all instances in which frequent observations were possible.

Of noteworthy interest is the fact that the coagulation time is shortened to a similarly striking degree in patients in whom it was pathologically prolonged, especially in jaundice. We have noted, for example, a drop from sixteen to two minutes. The curve was not observed, however, in the few patients suffering from blood diseases in whom we have had the opportunity to administer the drug.

*Changes in the Color of the Blood.*—The change in the color of the venous blood to a light arterial tint is usually present shortly after the introduction of the citrate solution. The return to the normal hue of venous blood is noted as the coagulation time again approaches that existing before the injection. In the few cases in which the coagulation reaction did not occur no change in the color of the blood was noted and we therefore regard this alteration in color as a characteristic element in the reaction. The appearance is that of venous blood that has been oxidized. Examinations made before and after citrate injections of the hæmoglobin, red blood-cell count, oxygen content of the blood,  $\text{CO}_2$  content, and total calcium content, as well as spectroscopic examinations, have revealed no changes, and we are therefore unable to account for the phenomenon at the present time.

*Consistency of the Clot.*—Concerning the clot that forms in the test tube or at the mouth of the injured vessel, there is every reason to believe that it is at least as solid after citrate injections as before. In fact, we have gained the impression that a tougher and more solid coagulum results from the introduction of the citrate. The best demonstration of the adequacy of the clot is, as will be shown, the permanent cessation of bleeding in the great majority of instances in which sodium citrate was used for this purpose. There was no evidence of intravascular clotting in any of our experiments, and in none of the patients to whom citrate was given was there any suggestion of thrombosis or of embolism.

*Manifestations After the Injection of Large Doses of Sodium Citrate.*—No manifestations other than local pain have ever occurred after the intramuscular injection of sodium citrate. The following have been noted occasionally after intravenous administration: trembling of the lips, tingling sensations in the fingers and toes, dizziness, nausea, or a sense of oppression and tightness across the chest and abdomen. There have been no untoward after-effects. No chills or elevation of temperature referable to the adminis-

tration of the drug were ever observed. No alteration in blood-pressure has been noted either during or after the introduction of the drug. Sodium citrate is said to have a toxic effect on the kidneys, but we have been unable to verify this clinically even when very large doses were given. Not even a diuretic effect was noted in carefully controlled studies. Up to the present the drug has been administered to two patients suffering from severe nephritis, without untoward manifestations. In short, we wish to emphasize the fact that no evidence of toxicity occurred with any of the large doses given, even though ten to fourteen grams have been administered in a number of instances.

For a period of about six months almost every patient admitted to the surgical service received citrate injections and the pronounced change in coagulation time was seen in nearly every instance, regardless of the disease from which the patient was suffering. The coagulation reaction following citrate administered in optimum doses did not occur in a very few patients. The conditions from which the patients suffered offered no explanation for the absence of the reaction. There were also three patients with cirrhosis of the liver and jaundice in whom the drop in coagulation time did not occur.

There are some cases in which a more prolonged effect is desired than that obtained from a single dose of citrate. We have attempted to sustain the shortened coagulation time by repeating the dose and have in some instances given the drug to patients four or five times within a period of a few weeks. Untoward effects were not noted. A sustained shortened coagulation time could not be maintained for more than four or five days.

*Nature of the Reaction. Contra-indications to the Use of Sodium Citrate.* Studies in blood chemistry, including oxygen and  $\text{CO}_2$  content and total calcium content, kindly carried out by Dr. Jerome Cohen, have shown that no changes occur as a result of the introduction of sodium citrate. Red blood-cell counts, hæmoglobin and spectroscopic examinations, have not shown changes. In a personal communication from Doctors Baehr and Rosenthal, who have studied many of our specimens of blood after citrate injections, we learn that they have determined that the action of sodium citrate is on the blood platelets. The platelets are destroyed with the consequent liberation of an excessive amount of a substance activating coagulation. It is therefore clear that in those diseases of the blood in which there is a platelet deficiency, notably in hæmophilia and purpura, the use of sodium citrate for the control of bleeding would be contraindicated. Before their studies were made we observed two cases of hæmophilia, one through the courtesy of Doctor Ottenberg, in which sodium citrate was administered in large doses. In both there was a slight primary drop in coagulation time with a marked secondary prolongation far beyond the original coagulation time. We have also had three cases of purpura and have noted results similar to those obtained in hæmophilia except that there was no primary drop in coagulation time but an immediate and continued prolongation. These few clinical observations strongly support the view held by Baehr and Rosenthal,

and we therefore feel that blood diseases are a clear contraindication to the use of sodium citrate. They also comprise the sole contraindication as far as our observations have gone.

*The Effect of Sodium Citrate on Bleeding.*—The evidence of the striking and sometimes remarkable effects of large doses of sodium citrate on bleeding in human beings rests on purely clinical observations. It can truly be said that bleeding would have ceased spontaneously in some, if not many, of the cases we have studied. Up to the present time, however, bleeding has been checked within an hour in the great majority of cases in which the citrate injection has been given for that purpose and the results can therefore be fairly attributed to the use of the drug.

Unless the underlying cause of a hemorrhage is cared for, recurrence of bleeding may of course take place, for the sodium citrate is only employed for the immediate control of hemorrhage. For example, a patient suffering from an incomplete abortion had been bleeding continuously for several days; bleeding stopped for twelve hours after the injection and then recurred and continued until the uterus was emptied. There were three cases in which hemorrhage controlled by sodium citrate recurred after various periods of time, to be permanently controlled by a second dose of the drug. These were a case of hemorrhage from a colostomy wound for carcinoma of the rectum, one of hemorrhage from the abdominal wall after an exploratory laparotomy for carcinoma in a jaundiced patient, and a case of polycythæmia with bleeding from the gums after the extraction of several teeth.

In all the remaining cases a single dose of sodium citrate permanently controlled the hemorrhage. The evidence of the control of bleeding of course varied with the nature of the case. In some instances it was obtained by operation, in some by aspiration, and in others by inspection or examination of vomitus, stool, etc. The clinical course alone established the evidence of cessation of bleeding in a number of instances. Case reports cannot be detailed in this publication. The cases fall into four groups:

*Internal Hemorrhage.*—Bleeding was controlled in cases of hæmatemesis, traumatic rupture of the liver, traumatic hæmothorax, hæmoptysis, and possibly in a case of cerebral hemorrhage.

*External Hemorrhage.*—These cases were varied. They include lacerated wounds, areas left bare by operation, post-operative hemorrhages from the rectum, the prostatic bed, and after operations on the common bile duct, and compound fractures.

*Bleeding Encountered at Operation.*—There were a number of impressive examples at cranial, abdominal, and other operations. One instance may be mentioned, a case that proved to be cirrhosis of the liver with icterus. The injection of sodium citrate was begun as the abdominal incision was made. In exploring the under surface of the liver an alarming hemorrhage was started. Packings failed to control this and the bleeding point or area could not be exposed. Without any other measure being employed, the

bleeding quite suddenly became less and ceased soon after. The excess blood was sponged away and the operation continued without further bleeding. A constant phenomenon was the rapid formation of coagula in wounds in which free oozing occurred.

*Bleeding Anticipated During Operation.*—In some cases it was difficult or impossible to determine any effect from the citrate injection because of the necessary sponging at operation. In other instances in which sodium citrate was given the operative field was manifestly less bloody than could have been anticipated. Examples of anticipated post-operative oozing that did not occur after citrate injections are several operations on the lungs and bone operations for acute lesions in which oozing was still going on at the end of operation. The cases of jaundice comprise a special group. In the past two years there have been operations on twenty-five patients with jaundice of varying duration, due to common duct stone in the great majority of the cases, in which sodium citrate was given as the anaesthesia was begun. In not a single instance was there the dreaded excessive oozing at operation, although in many of the cases coagulation time and bleeding time had been pathologically prolonged. There were no post-operative hemorrhages. Oozing at later periods after operation occurred in a few cases, to be controlled by one or repeated doses of sodium citrate. There was not a single instance of a post-operative hæmatoma in the wound in the six months in which sodium citrate injections were used as a routine for all cases at the time of operation. At the present time we use sodium citrate in every case on our service in which there is any suspicion that oozing may be encountered at operation, and this prophylactic use of the drug has frequently proven of great value.

#### SUMMARY

1. The administration of sodium citrate intramuscularly, intravenously, or subcutaneously, results in prompt and pronounced shortening of coagulation and bleeding time. This is a hitherto unrecognized pharmacological action of the drug.
2. The shortened coagulation time is of two to three hours' duration with gradual return to the normal within twenty-four to forty-eight hours.
3. The sodium citrate curve occurs not only in individuals with normal coagulation and bleeding time, but also in those in whom there is pathological prolongation, notably in jaundice.
4. It does not occur in blood diseases characterized by blood platelet deficiency—hæmophilia and purpura. These diseases appear to comprise the sole contraindication to the use of sodium citrate for the control of bleeding.
5. The dose for intramuscular administration of sodium citrate is nine grams for adults. A thirty per cent. solution is used, fifteen c.c. into each buttock, preceded by novocaine. The intramuscular method is free from danger, no untoward results having been noted in 200 cases, and is therefore the method of choice.

6. Internal as well as surgical bleeding, hemorrhage not only in normal individuals, but also in those with prolonged coagulation time are decisively controlled by sodium citrate injections in the great majority of cases. These are cases of oozing surfaces or hemorrhage from small vessels, for control of hemorrhage from large vessels cannot be expected with the dosage of the drug at present employed.

7. The method offers as well a large sphere of usefulness as a prophylactic measure against oozing at operation, especially in cases in which much bleeding is anticipated.

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- <sup>1</sup> R. Weil: Jl. A. M. A., 1915, vol. lxiv, p. 425.
- <sup>2</sup> R. Ottenberg: Proc. Soc. Exp. Med. and Biol., 1916, vol. xiii, p. 104.
- <sup>3</sup> R. Kinsella and G. Brown: Jl. A. M. A., 1920, vol. lxxiv, p. 1070.
- <sup>4</sup> H. Neuhof and S. Hirshfeld: N. Y. Med. Jl., Jan. 15, 1921.

# FACTORS WHICH INFLUENCE LONGEVITY IN CANCER\*

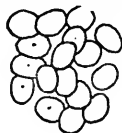
A STUDY OF 293 CASES

By WILLIAM C. MAC CARTY, M.D.

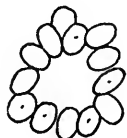
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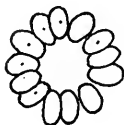
PRACTICALLY every surgeon, clinician, and pathologist who follows post-operative results in cancer has occasionally been surprised to find that in some of his extensive cases patients live much longer post-operatively than others



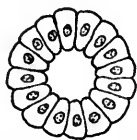
0° Differentiation



1° Differentiation



2° Differentiation



3° Differentiation

FIG. 4.—Degrees of cellular differentiation based on the stages of differentiation of specific tissues during embryologic development. In the stage without differentiation the cells are merely arranged in masses. In the first degree of differentiation the cells assume the general alignment of the adult tissue but without arrangement of the axes of the cells as in the adult tissue cells. In the second degree of differentiation the axes are parallel or form radii of a sphere or circles. In the third degree the cells assume the adult morphology of the units of the specific tissue.

with easily removable small growths. Such experience with cancer, after resection, led to the following investigation.

• The material for study consisted of ninety-nine cancers of the stomach,<sup>1</sup> ninety-two cancers of the breast, and 102 cancers of the rectum. All the

\* Presented before the Minnesota Pathological Society, November 15, 1921.

patients were known to have died of recurrence or metastasis after extensive radical removal of the growth. The specimens were studied to determine the frequency and possible influence of lymphocytic infiltration, fibrosis,

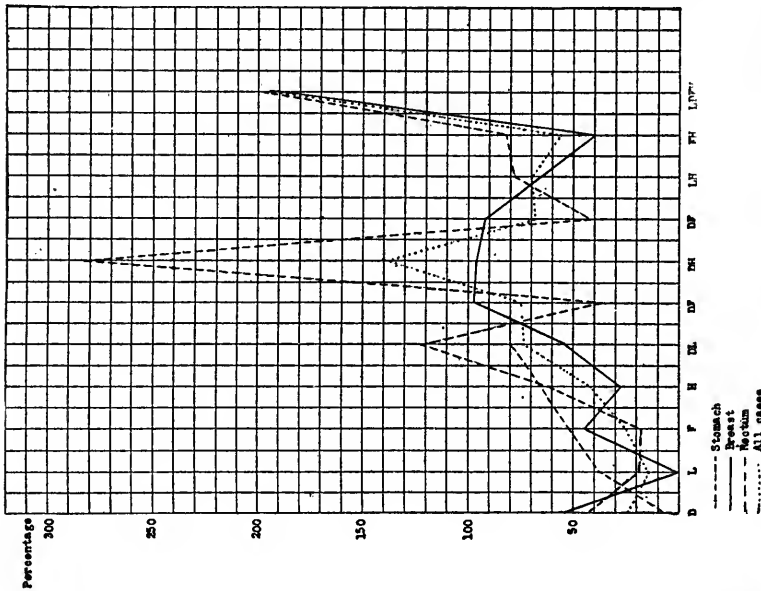


FIG. 6.—Percentage increase of post-operative life with factors checked against post-operative life without factors.

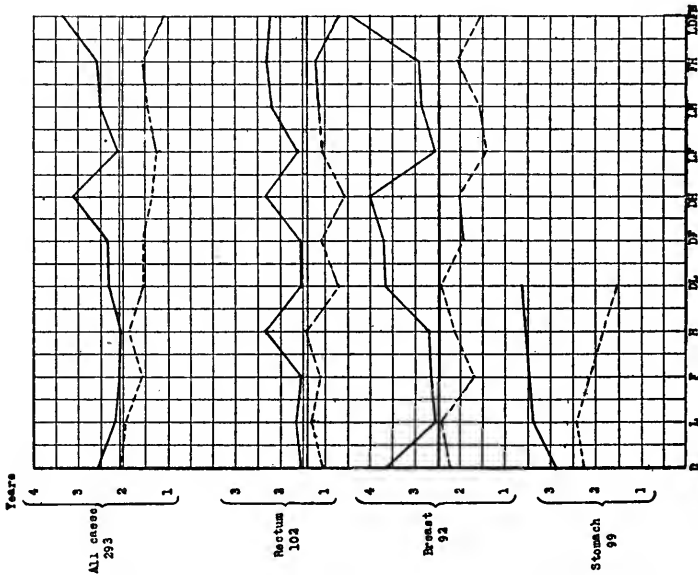


FIG. 5.—Average length of post-operative life with and without factors.  
Solid line : duration of life of patients with the factor  
Dotted line : duration of life of patients without the factor

hyalinization and cellular differentiation on post-operative longevity. Lymphocytic infiltration, fibrosis, and hyalinization were considered to be present only when they were found in intimate association with the cancer cells (Figs. 1, 2, and 3). By cellular differentiation is meant the structural changes which take place in the evolution of an adult tissue cell (Fig. 4).



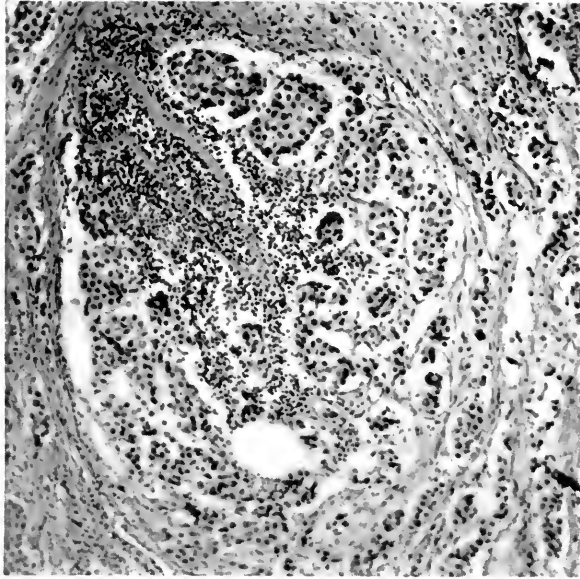


FIG. 1.—Lymphocytic infiltration intimately associated with cancer cells.

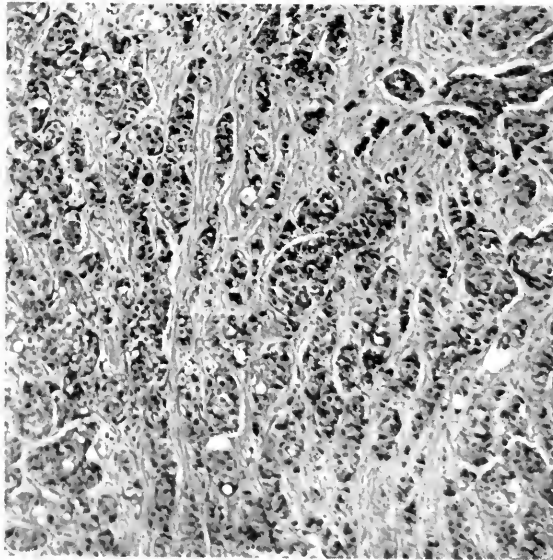


FIG. 2.—Fibrosis intimately associated with cancer cells.

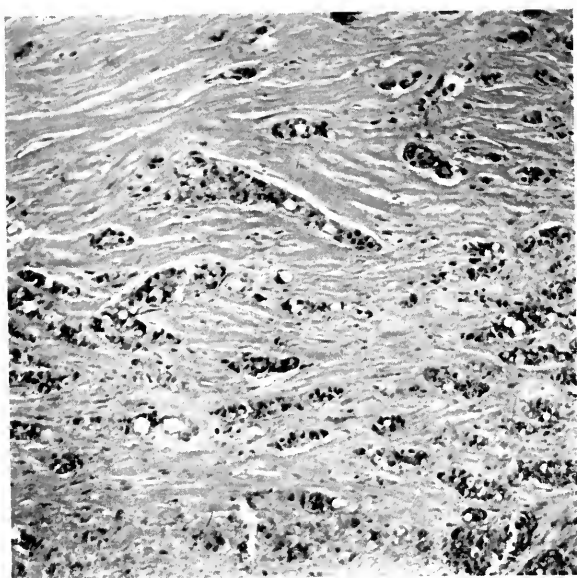


FIG. 3.—Hyalinization intimately associated with cancer cells.

## FACTORS WHICH INFLUENCE LONGEVITY IN CANCER

An examination of the facts, charted in Figure 5, reveals that the average length of post-operative life is greater when the factors are present singly or in combination. When the facts are studied from the standpoint of percentage increase of post-operative length of life and checked against the average post-operative length of life without the presence of the factors, it may be seen (Fig. 6) that in the whole series there is a marked increase. If one charts the facts, from the standpoint of percentage increase in post-

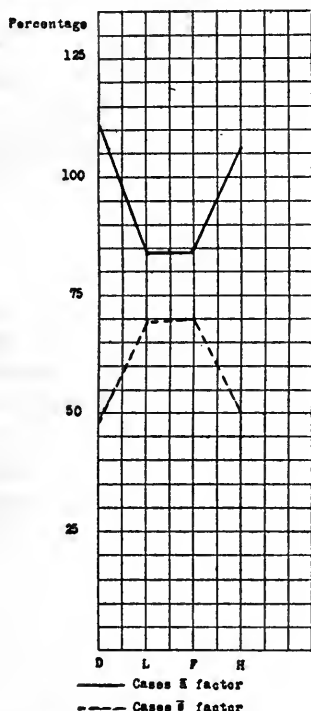


FIG. 7.—Average percentage increase of post-operative life in the presence of one factor (alone and in combination) checked against the absence of the factor.

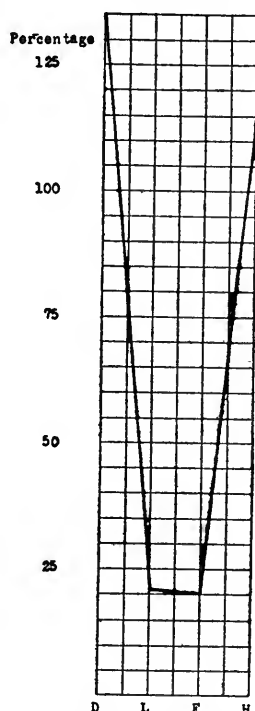


FIG. 8.—The percentage difference between the average length of post-operative life with and without the factors (alone and in combination) checked against their absence.

operative life in the presence of one factor (alone or in combination), checked against the absence of that factor, it may be seen (Fig. 7) that differentiation and hyalinization apparently play the greatest rôle in influencing the longevity. This is more striking if the percentage difference between the average length of post-operative life, with and without the factors (alone and in combination), is checked against their absence (Fig. 8).

In conclusion, it might be stated that the uniform consistency of increased length of post-operative life (in the presence of lymphocytic infiltration, fibrosis, hyalinization, and cellular differentiation) suggests that these factors play a significant rôle as a part of the natural defensive mechanism against cancer after it has once developed.

# WILLIAM C. MACCARTY

## DATA OBSERVED IN THE SERIES OF 293 CASES.

	Stomach	Breast	Rectum	Total
Cases	99	92	102	293
Average length of postoperative life...	2.62 years	2.5 years	1.47 years	2.19 years
Frequency of differentiation.....	65 per cent.	8.6 per cent.	86 per cent.	53.2 per cent.
Frequency of lymphocytic infiltration..	91 per cent.	60 per cent.	57 per cent.	69 per cent.
Frequency of fibrosis.....	.....	68 per cent.	75 per cent.	71 per cent.
Frequency of hyalinization.....	.....	52 per cent.	2 per cent.	27 per cent.
Frequency of differentiation and lymphocytic infiltration.....	.....	6 per cent.	56 per cent.	31 per cent.
Frequency of differentiation and fibrosis.....	.....	7 per cent.	70 per cent.	38 per cent.
Frequency of differentiation and hyalinization.....	.....	4 per cent.	2 per cent.	3 per cent.
Frequency of lymphocytic infiltration and fibrosis.....	.....	40 per cent.	47 per cent.	43 per cent.
Frequency of lymphocytic infiltration and hyalinization.....	.....	27 per cent.	1 per cent.	14 per cent.
Frequency of fibrosis and hyalinization.....	.....	52 per cent.	2 per cent.	27 per cent.
	Years	Years	Years	Years
Average length of postoperative life with differentiation.....	2.73	3.65	1.54	2.64
Average length of postoperative life without differentiation.....	2.56	2.37	1.08	2.0
Average length of postoperative life with lymphocytic infiltration.....	2.73	2.51	1.57	2.6
Average length of postoperative life without lymphocytic infiltration.....	2.7	2.48	1.31	2.16
Average length of postoperative life with fibrosis.....	.....	2.72	1.53	2.12
Average length of postoperative life without fibrosis.....	.....	1.87	1.29	1.58
Average length of postoperative life with hyalinization.....	.....	2.81	2.33	2.57
Average length of postoperative life without hyalinization.....	.....	2.21	1.44	1.82
Average length of postoperative life with differentiation and lymphocytic infiltration.....	2.8	3.78	1.59	2.72
Average length of postoperative life without differentiation and lymphocytic infiltration.....	1.55	2.45	0.71	1.57
Average length of postoperative life with differentiation and fibrosis.....	.....	3.87	1.58	2.72
Average length of postoperative life without differentiation and fibrosis.....	.....	1.96	1.15	1.55
Average length of postoperative life with differentiation and hyalinization.....	.....	4.0	2.33	3.16
Average length of postoperative life without differentiation and hyalinization.....	.....	2.04	0.61	1.32
Average length of postoperative life with lymphocytic infiltration and fibrosis.....	.....	2.69	1.65	2.17
Average length of postoperative life without lymphocytic infiltration and fibrosis.....	.....	1.4	1.17	1.28
Average length of postoperative life with lymphocytic infiltration and hyalinization.....	.....	2.76	2.25	2.5
Average length of postoperative life without lymphocytic infiltration and hyalinization.....	.....	1.68	1.27	1.47
Average length of postoperative life with fibrosis and hyalinization.....	.....	2.89	2.33	2.61
Average length of postoperative life without fibrosis and hyalinization.....	.....	2.05	1.28	1.66
Average length of postoperative life with lymphocytic infiltration, differentiation, fibrosis and hyalinization.....	.....	4.4	2.25	3.32
Average length of postoperative life without lymphocytic infiltration, differentiation, fibrosis and hyalinization.....	.....	1.52	0.76	1.14

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## THE FATAL OUTCOME OF CERTAIN CASES OF STAPHYLOCOCCUS INFECTIONS OF THE FACE AND LIPS\*

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WHEN I was studying medicine, thirty years ago, my attention was arrested by a statement in Treves' *Applied Anatomy*<sup>1</sup> regarding the facial vein. Mr. Treves called attention to the dangerous nature of infection of the face on account of the anastomosis of the superior ophthalmic vein with the facial at its origin at the root of the nose, so that a thrombophlebitis would readily travel along the facial vein through the ophthalmic to the cavernous sinus. I somehow got in my mind that the facial vein was a dangerous vein. Thereafter, whenever I resected or saw resected a superior maxilla and the incision started just over the angular vein and was carried down through the skin at the junction of the nose and cheek, I always had an uncomfortable feeling that this dangerous thrombosis might be started from the divided vein. It never did, however. As years passed I saw many infections of the face, some of them starting from infections about the hair follicles in the nostril. In these the lip was swollen; the nose was shiny and deep red; the eyelids were oedematous; but they all recovered after the discharge of a small amount of pus. Others were of the eyebrow and there were several of the chin. Finally I saw an extensive staphylococcus infection of the upper lip. The lip was hard, twice its usual size and dusky red. The cheeks and sides of the nose were swollen and hard; the eyelids were oedematous. The lip had been incised in several places. The surfaces of the incisions were covered with a grayish-yellow slough. The man recovered.

Shortly after, in 1911, a woman entered my service in St. Luke's Hospital with a similar condition. Forty-eight hours afterward she was dead. Since then, during the last twelve years, we have had in St. Luke's Hospital, including both services and in the private pavilion, seven patients with extensive infections of the lip. Of these six have died. I have seen one outside the hospital. He recovered. There was one case in 1915, one in 1916, one in 1918, two in 1920, one in 1921 and one in 1922. These were all extensive staphylococcus infections of the lip with multiple foci—examples of the condition we usually call carbuncles. One was of the lower lip and the others were of the upper lip. During the same period we have had eighty carbuncles of the neck, with five deaths. We have had a number of small furuncles of the face in patients going to the Out-patient Department and on the nursing staff. I have not included these.

I have thought it might be of interest to review these cases; to study the cause of death; to compare them with reports of similar cases published

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from time to time and to discuss the perplexing problems presented, especially as regards etiology and treatment.

The papers and case reports which have appeared are curiously similar and curiously dissimilar. The writer of the paper has usually seen one rapidly fatal infection of the lip. He has been shocked by the unexpected outcome. Strangely enough, the patient has very often been a young doctor or medical student. Within a comparatively short period he has seen other staphylococcus infections of the lip which have not died and he believes that the treatment of the furuncle in the first instance has been at fault. If the patient has died it is because the furuncle has been incised, or an exactly opposite conclusion has been reached and the opinion has been expressed that the incision has not been made early enough or wide enough. I will quote two examples: Lanz,<sup>2</sup> writing two years ago in Amsterdam, begins his article most dramatically as follows:

"Three of us were intern assistants in Kocher's Clinic in Bern. One of us was attacked by a furuncle on the upper lip and had this furuncle incised by an expert. Four days later he was dead. . . . Since that time I have no longer believed in incision in lip furuncles."

Doctor Powers<sup>3</sup> wrote in a paper published in February, 1901, twenty years earlier: "In 1886 a young physician attached to the Out-patient Department of the Chambers Street Hospital complained one day of a boil on his upper lip. Two days later we were greatly surprised and grieved to learn that he was dead." He concludes his article by advising early and wide excision of lip furuncles. Every year or two some such article appears.

Now we all know that superficial staphylococcus infections of the face and lips are very common; folliculitis barbæ in which the ordinary pyogenic staphylococci set up an inflammation, often purulent, in the hair-follicles of the beard are not uncommon, and pustular forms of common acne, solitary pimples and small boils are of everyday occurrence.

What is the interpretation of the particular gravity of infection by similar organisms in certain cases? Why have we five deaths only among eighty carbuncles of the back of the neck, many of these in the old, enfeebled, the diabetic and seven deaths in ten patients with carbuncles of the lip, all but one below forty-five years old? Why has death followed promptly after admission? In only one instance has death been delayed more than four days; four died within forty-eight hours.

The first thought on seeing these patients is that we are dealing with some unusual form of infection. Before 1880 a discussion of the subject invariably brought up the question of the type of infection. There were many discussions as to whether the patients were suffering from a malignant pustule or carbuncle. It must be remembered in reading these discussions that the word "anthrax" is used as it is in France to-day for carbuncle caused by staphylococcus. For instance, the cases reported in one of the early English papers on "Carbuncular Inflammation of the Lips and Other

Parts of the Face," by Mr. Harvey Ludlow (1852),<sup>4</sup> were said by Doctor Budd (1863) to be all characteristic examples of malignant pustules. Thomas Smith,<sup>5</sup> in *Holmes' Surgery* (1871), ventured to dissent entirely from this assertion. It has, however, now long been recognized that the infection is caused by the staphylococcus aureus. Repeated examinations and cultures have shown this organism usually in the pure culture.

Whether or not they represent examples of infection by unusual, virulent strains brings up very interesting questions. It is well known that within the same species of bacteria different strains may differ widely in virulence and that these differences may be readily artificially produced. They represent an adaptation of the bacteria to conditions met with in the medium in which they are grown. Increased virulence is related to conditions favorable for luxuriant growth. The astonishing rapidity with which microorganisms multiply is well known. Assuming that each one divides every half hour, then in twelve hours each will have more than fifteen million descendants. It would not be astonishing to find in the vast numbers present, even in a small infected area, after twenty-four or forty-eight hours, those that show especial adaptability to the conditions present and that grow luxuriantly. There seems to be no reason to believe that bacteria of unusual virulence are commonly found on the lips. I know of no instance of severe infection following operations for harelip, or following wedge-shaped excisions of the lip for new growths, or following resections of the superior maxilla. It is generally recognized that lacerated and even contaminated wounds of the face and lip heal most satisfactorily.

For fifty or sixty years the fact that thrombosis of the cavernous sinus may follow infections of the lip has been mentioned in text-books of surgery. The protrusion of the eyeball, the œdema of the lids, the swelling and eversion of the conjunctiva are obvious signs of the condition. Such was the clinical picture in Case II of our series. Furthermore, at autopsy, not only have purulent thrombi been found in the sinus, but the suppurative phlebitis of the ophthalmic vein, on one or both sides, has often been recognized. These were the autopsy findings in Case VII of our series. But in the third case reported, death followed infection of the lower lip and there was a red, indurated, brawny swelling extending in the neck, not up toward the eye; and in the autopsy findings in Case VIII, although the infection was of the upper lip and there was moderate œdema of both eyelids, the autopsy findings showed no lesion of the brain, meninges, ophthalmic vein or cellular tissue of the orbit. The patient died of staphylococcus sepsis with multiple septic infarcts of the lung. The day before death the blood culture was positive for staphylococcus aureus.

In 1869, Reverdin<sup>6</sup> made an autopsy on a woman who had died following a carbuncle of the lower lip. Both lungs presented numerous metastatic abscesses. The meninges, sinus and brain were normal. As the body was not claimed, two days later he made a dissection of the face. The internal jugular vein was

healthy; a recent clot occupied the part of the vein adjacent to the angle of the jaw. The external jugular was filled in its cervical portion with a fibrinous clot mixed with liquid blood. Its facial portion and the tributary branches were obstructed and filled with broken-down blood clot, forming a reddish-gray, grumous material. The angular vein was completely obliterated in all its extent up to the angle of the eye; one of the labial veins was obliterated, as well as several of the muscular branches. Finally, a large branch, which passes over the jaw to empty into the internal jugular, was filled with a broken-down blood clot which ended in a point within the lumen of the internal jugular. He summarized his observations thus:

"Phlebitis of the facial vein, starting at the level of the commissure of the lips, extending, on the one hand, upward to the inner canthus of the eye but stopping there, on the other, by the transverse vein of the face to the external jugular and from there by an anastomosing branch to the internal jugular." An infected clot was projecting into the jugular; a portion of it had evidently broken off and been swept away by the blood stream.

Unfortunately, it has not often been possible to dissect out the thrombosed veins of the face, but at the time Reverdin wrote there had been ten similar observations. In each instance a purulent phlebitis had been traced from the focus of infection. This thrombophlebitis extends from the focus of infection often upward along the angular to the ophthalmic vein, but not uncommonly downward to the jugular. Obviously, such an infectious phlebitis can cause death in two ways: either by involvement of the cavernous sinus and the concomitant intracranial lesions or by a portion of the clot containing multitudinous organisms breaking off and being carried away by the venous circulation to the right heart and hence to the lungs.

Lenhartz,<sup>7</sup> in his book on Septic Diseases, gives the autopsy findings in eight cases of staphylococcus sepsis following furuncles on the lip, nose or eyelid. He calls attention to the striking tendency for an infective thrombophlebitis of the facial vein to follow infections of the upper lip.

Lenhartz quotes his second case to show that death may occur from sepsis and yet no suppurative thrombophlebitis be recognized at autopsy. The patient, a girl twelve years old, had had a furuncle of the upper lip. When she entered the hospital, two days later, the lip and left cheek were much swollen and several cords could be felt in the cheek. Both jugulars were ligated and the œdematous swelling incised. The entire upper lip was studded with small purulent foci. She died the next day. The lungs and kidneys showed septic infarcts. There was no evidence of thrombophlebitis in any of the veins or the ophthalmic. There is no record, however, of a careful dissection of the small veins of the face. In two of his autopsies there was a massive phlegmon of the face, diffuse purulent meningitis and infarcts of the lung. He gives these as examples of the spread of infection through the orbit to the meninges by direct progression through the lymphatics and cellular tissue.

We all know that the staphylococcus blood-stream infection occurs from cocci entering the blood from small foci of infection. Every hæmatogenous osteomyelitis is an example. But in these there is no massive blood infection,



with evidence of infarcts in the lungs, in question. The rarity of such a condition following furuncles or carbuncles situated elsewhere furnishes a striking contrast to the frequency of suppurative thrombophlebitis following furuncles of the lip. It is in this that the danger of the lesion lies. A malignant furuncle or carbuncle of the lip is a furuncle or carbuncle accompanied by a suppurative thrombophlebitis, and the danger of the condition lies in the tendency for infection, situated in the lips and nose, to involve the labial venous plexus.

The skin of the lip is very adherent to the underlying muscles, the fibres of which are inserted into the derma. There is little or no loose connective tissue and fat beneath the skin; the main substance of the lip is made up of a network of muscle and connective tissue. The muscles in general are arranged in two sets: first, a group of curving fibres forming a true sphincter about the oral orifice (the orbicularis oris), and second, a group rising from various parts of the face and converging toward the oral orifice and interlacing with the orbicularis. These muscle fibres are imbedded in a dense connective tissue making up the substance of the lip. There is a rich venous plexus which cuts obliquely the direction of the orbicularis oris, one portion of the venous network being superficial, one being beneath the muscle. The collecting venous trunk for the upper lip ascends along the nasolabial groove to empty into the facial at a point at the level of the nostril or even at the lower border of the orbit. There are usually two rather slender collecting branches for the lower lip. They ascend obliquely and the lower empties into the facial low down in the submaxillary portion. There are no valves in the facial vein; at least, the vein can be readily injected from the jugular; but the labial veins have numerous valves so that it is difficult to force injection into them from the facial.<sup>8</sup>

When a furuncle or small staphylococcus infection passes beyond the skin or mucous membrane of the lip and penetrates the substances of the lip, it can only spread in the complicated framework of dense connective tissue between the various muscle bundles and in close contact with a rich plexus of veins. Thus it is not surprising that a suppurative thrombophlebitis is readily established. When this thrombophlebitis becomes progressive and spreads to the collecting veins two additional factors, I believe, almost always come into play—motion and trauma.

The first principle of treatment for phlebitis is rest. At the onset of infection of the veins, before the lips have become greatly distended, every contraction of the various muscles entering into the complex musculature of the mouth must press and squeeze the thrombosed, infected veins.

Rosenbach<sup>9</sup> suggests (a rather fanciful view) that the anatomical relation of the muscles of the skin and the cellular tissue is such that infectious material is forced and "pumped" into the neighboring connective-tissue framework.

The second factor is trauma. A small pimple has been squeezed or

pressed; a needle or pin has been thrust into the inflamed area. The disfigurement of the trifling infection seems of great moment and, in front of a glass, with various grimaces, the infection is attacked. If it does not subside medical aid is sought; the small furuncle is pricked or stabbed or a pointed orangewood stick covered with carbolic is thrust into the supposed centre. The doctor is spurred on by the requests of the patient to be immediately relieved of the unsightly lump. Furuncles that would be carefully preserved from injury in other parts of the body less open to inspection are, in this situation, subject to repeated insult. This is not a fanciful picture.

Case history after case history shows the same story: a small furuncle with redness and swelling, usually of only one or two days' duration, is pricked or squeezed. It usually becomes worse; a physician is called. He makes a small wound or thrusts a blunt instrument into it. The place of puncture is not determined by a visible focus. After each incision the patient grows worse.

If a small puncture is made through the derma into the firm connective and muscular tissues of the lip, it is almost certain to sever or nick one of the smaller veins. The blood escapes only partially externally; a portion spreads out along the lines of least resistance within the tissues. This is all the more marked if the small wound is tightly packed. Now stagnant blood within the tissues, in an infected area, furnishes an excellent culture medium for bacteria. Dorst<sup>10</sup> has found it increases about forty-fold the potency of staphylococci.

About every focus of infection a wall of leucocytes is rapidly formed. On the integrity of this wall depends whether or not the microorganisms advance into the tissues. This wall is at first very delicate; as time passes it becomes better and better established. The experiments of Giani<sup>11</sup> are interesting in this connection. He soaked filter paper in a virulent culture of anthrax bacilli, then laid the piece of paper as gently as he could on the surface of fresh wounds two, six, eight, ten and fourteen hours after the division of the tissues. If, by the slightest roughness, the protecting wall of leucocytes which had already formed at the end of two hours, was broken (he recognizes this by slight signs of hemorrhage) the animal died. Even at two hours a third of the animals survived. At the end of fourteen hours the wall was strong enough to resist these gentle manipulations and all recovered.

Punctures and rough manipulations may, time after time, break through this protecting cellular wall. Hardly has the protecting wall again formed when it is again broken through until finally a widespread and dangerous infection is established. In Case VI, for example, the small pimple was pricked, then squeezed and twice incised within the first twenty-four hours.

As we have said, the papers on this subject come to very different conclusions regarding treatment. If we examine the reported cases, some foundation may be found for these varying conclusions. Obviously, results

of treatment can only be judged when all the lesions are taken into consideration. Is the case reported a simple furuncle of the lip; is this complicated with phlebitis; is the phlebitis progressive; is there massive infection of the blood-stream from portions of broken-down thrombus; have bacteria only entered the circulation from the focus? These are questions that must be asked in every instance.

In Case VIII, for example, blood culture made the day of admission was positive for staphylococcus aureus, and at autopsy, two days later, there were multiple septic infarcts of the lung. It would be unwise to draw conclusions as to the efficacy of any form of local treatment to the lip carried out after this patient entered the hospital.

Reverdin (*loc. cit.*) was convinced from the following case that early and wide incision should be done: A woman, twenty-two years old, ordinarily in good health, had a hard, infected area about the size of a nut on the lower lip near the commissure. It was yellowish red on the summit and the neighboring portions of the lip were swollen and hard. She had had the infection two days. Reverdin made a deep, crucial incision. She grew worse during the night. The next day the whole lip was greatly swollen and hard and the temperature was 104. She was taken to the hospital and a wide incision was made through the infected area; only a few drops of pus escaped from the wound. Numerous small, yellowish foci were seen scattered through the incised area. Two days later a hard cord could be felt beginning above the clavicle and extending along the medial border of the sternomastoid; it became indistinct above, being merged into the sub-maxillary swelling. Three days later the fourth operation was done—opening a collection of pus under the chin. She recovered. She was seen early when there was no widespread infection; the infection spread after every operation; she was desperately ill and developed a suppurative phlebitis. Did the frequent incisions favorably or unfavorably influence the spread of infection?

Rosenbach (*loc. cit.*) also believed in wide and early incisions. I report his first case: The patient was a sixteen-year-old boy, who came under his care five days after the onset of his infection. The whole upper lip and left side of the cheek were swollen and hard; on each side an indurated cord extended upward from the furuncle. Under general anæsthesia the entire focus in the upper lip was opened, one incision passing vertically through the lip, the other transversely. Incisions were made as well through the most indurated portions of the swellings on the chin and cheek. The following day two more incisions were made as the infiltration was progressing on the chin. Two days later the necrotic tissue began to loosen, but, as the left cheek was infiltrated, red and painful, this tissue was incised. A few days later the infiltration had spread to the parotid region and neck. Shortly after, the right ankle became inflamed and was subsequently incised. Four months afterward the scars on his face had healed and the patient had a stiff ankle-joint and a discharging sinus. The infection advanced after each operation. The patient finally had a blood-stream infection with a metastasis.

In the first case reported by Powers (*loc. cit.*) the carbuncle was of moderate size. The cheek was swollen alongside the nose to the margin of the orbit. The indurated area was freely incised and the necrotic mass excised. His second and third cases were similar. They all recovered satisfactorily. He tells of a disfiguring scar in the first. In none of his cases was there evidence of a thrombophlebitis.

On the other hand, Walters, Coombe and Solly<sup>22</sup> reported in 1909 a very

extensive, indurated, staphylococcus infection starting close to the commissure of the lip, with œdema of the lid, brawny induration of the entire cheek spreading to the submaxillary and parotid region. The child was treated with vaccines and the administration of repeated doses of citric acid and recovered. I refer to this case, not to call attention to the efficacy of vaccines or citrates, but to show recovery without incision.

In 1910, Keppler<sup>13</sup> reported twelve cases of facial infection treated successfully by Bier's constriction method. Only four of these, however, seemed severe. Here again I refer to the cases not on account of the treatment by hyperæmia, but to show that they recovered without early or wide incision or excision. He applied his constriction, simply lifted gently the head of the pustules, waited for the cores to loosen and removed them.

A few months later Wrede,<sup>14</sup> from Lexer's Clinic, reported eight cases of lip furuncles, without a complicating suppurative phlebitis, which he had treated conservatively, that is, without incision. He criticised justly Keppler's treatments on the ground that the artificial hyperæmia obscured the clinical picture, prevented satisfactory inspection of the progress of the infection and the detection of complicating suppurative phlebitis. Lexer,<sup>15</sup> even, reports a case of fatal sepsis following a single treatment of a small lip furuncle by suction. Both Lexer and Wrede advised wide incision through the indurated areas when a progressive, suppurative phlebitis is present.

Lenhartz (*loc. cit.*), in his most interesting book on Septic Diseases, says that he is opposed to early incisions of lip furuncles. He had had the opportunity of watching on two services of the Eppendorfer Hospital the two plans of treatment. While he has seen many recoveries following wide and early incision, he has also seen many disasters. This testimony is interesting as coming from a medical man, especially interested in the autopsy findings in sepsis.

My own views are that although furuncles and pimples of the lips and face are very common and usually subside, even when they are squeezed, pressed, pricked and punctured, these are dangerous measures to apply to any infection and are especially dangerous in the lip. The knowledge should be widespread that every furuncle of the face and nose, and especially of the lip, should be treated as if it might become a dangerous disease. It should be more generally recognized that danger lies in a complicating suppurative thrombophlebitis, and that mechanical injury, the arrangement of the labial plexus of veins and the inevitable movements of the parts are factors of great consequence in spreading infection.

I believe that early operations and rough manipulations in the infected area tend to spread, not to limit, the infection. The small infection should be kept at rest, the skin about it gently cleansed and covered with some simple ointment. The focus of infection should not be rubbed or squeezed or pricked or handled. It is dangerous to try to abort furuncles by puncture through the white or red point with a toothpick or wooden applicator dipped in phenol, nor should phenol be injected in the indurated tissue.<sup>16, 17</sup> Early puncture before there is a definite focus of suppuration and then tightly packing the small hole to arrest bleeding is admirably suited to create con-

ditions in the dense tissue of the lip favorable for rapid bacterial growth and the spread of infection to the labial veins.

Considerable induration about the focus of infection and œdema of the loose cellular tissue of the eyelids is not uncommon in moderate infections and is not a sign of ophthalmic phlebitis.

Local anæsthesia should never be used; the infiltration still further increases the tension and may force infectious material deeper into the tissue. Incision with a sharp knife is indicated if there is a local abscess or if the parts have become enormously swollen and livid or for intolerable pain. If it is necessary to incise widely in infections of the upper lip with extension along the angular vein, the incision should follow the line of incision for resection of the superior maxilla.<sup>18</sup> When and how much to incise must depend finally on the judgment and experience of the individual surgeon. Sharp severance of the tissues relieves tension. It can do no harm unless it is accompanied, as it so often is, by pressing, squeezing or pushing blunt instruments into the severed tissue searching for collections of pus. Usually there is no free pus; there are scattered purulent foci and a hard, necrotic core. Unfortunately, it is generally necessary to stuff the wound with gauze to stay the copious hemorrhage. This gauze rapidly becomes adherent to the wound surface and soon checks any outflow from the wound. Furthermore, the removal of the adherent gauze is apt to cause bleeding and injury to the newly formed granulations.

The fatal cases we have reported were all examples of widespread, general infection or cavernous sinus thrombosis complicating an infection of the face when they came under observation. No local treatment of the original focus could avail; all were widely incised under general anæsthesia. We considered, but rejected, the idea of opening the cavernous sinus in two of the patients in whom the infection had already reached that point. The cavernous sinus has been incised a number of times. A paper was published in 1902 on the subject and a case reported by Dwight and Germain.<sup>19</sup> Tavernier<sup>20</sup> some years later also reported a case. One patient lived a few hours and the other ten minutes or more after the operation. Not only is the sinus difficult to approach but conditions in the sinus are not at all like those in the lateral sinus. The lumen is divided up by a network of round and flat trabeculæ and an infected clot caught in the meshes of the sinus network cannot be removed by a curette. Large veins also enter at a number of points along which infection can readily travel. The idea that thrusting a knife into the sinus might influence favorably the spread of infection seems to me to show singular ignorance of the morbid anatomy.

Both the jugular vein and the facial have been ligated with the idea of preventing the spread of infection. Lexer (*loc. cit.*) reported a case of carbuncle of the cheek in which there was a purulent thrombophlebitis of the facial and general infection and in which he was able to avoid further metastases and cure the patient by ligation of the jugular. Ligation of the

jugular should be considered in cases where there is a blood-stream infection and signs of general sepsis. It might have been considered in Case VIII of our series. The autopsy findings showed, however, a lesion of the lungs sufficiently advanced to make it very improbable that ligation would have controlled the spread of the infection. In other words, when the patient entered the hospital massive infection of the blood-stream had already occurred.

Tavernier (*loc. cit.*) mentions the ligation of the jugular vein by Texier, but the plexus of veins and numerous anastomoses, the massive infiltration of the surrounding cellular tissue, all make it difficult to recognize the thrombosed veins. Obviously, ligation should only be done on a sound vein wall at an appreciable distance from the infected thrombus. The distance between the entrance of one of the labial or nasal veins to the point where the ophthalmic vein enters the angular is very short, often hardly an inch. It seems to me that there would be a real danger of disturbing and loosening a thrombus in the endeavor to ligate at this point. In none of our cases, I believe, would ligation of the angular at the time they came under observation have prevented the involvement of the cavernous sinus.

My attention has been directed by these fatal cases, in which the failure of any form of treatment was to be expected, to the endeavor to determine the conditions which change a simple circumscribed staphylococcus infection into a widespread and dangerous lesion, and I cannot escape the conclusion that many such simple lesions are often so changed by ill-advised treatment at the onset of the infection.

Reading over many of the case reports recalls to my mind the treatment advised by Dr. San Grado in Le Sage's romance of "Gil Blas." Dr. San Grado believed in bleeding and in the ingestion of large quantities of water. When his patients died he believed he had not bled them enough or caused them to drink enough water. These conclusions applied logically during a long lifetime lead to an astonishing mortality.

## RECORD OF CASES

CASE I.—F. S., age forty-four. Admitted July 17, 1911. Died July 19, 1911. Diagnosis: Carbuncle of upper lip, cellulitis of face, septicæmia. Operation: Multiple incisions.

Patient had a boil on upper lip which gradually began to swell, became very red and painful. Her physician had incised it twice in two days, but her condition continued to grow worse.

Upper lip enormously swollen and indurated and dusky red. Side of nose and adjacent parts of face much swollen; lids œdematous.

Under general anæsthesia multiple incisions were made through inflamed tissue. No free pus found. Firm grayish-red surface on cut surfaces.

Temperature: On admission 105, 104.3, 105.2; second day, 104.3, 104.1, 104.4, 104.3; third day, 106.4 (died).

CASE II.—L. G., age thirty-four. Admitted May 22, 1915. Died June 20, 1915. Diagnosis: Cellulitis of face, cavernous sinus thrombosis, staphylococcus septicæmia. Operation: Multiple incisions in lip and incisions in orbital cellular tissue.

## STAPHYLOCOCCUS INFECTIONS OF THE FACE AND LIPS

Small infection inside nostril was pricked, then incised and squeezed. Swelling and induration extended to lip, then along naso-facial groove. Both lids became oedematous, conjunctiva much swollen and red, protruding between eyelids; cellular tissue of orbit obviously infiltrated.

Multiple incisions made under general anaesthesia; small amount of free pus evacuated. May 22nd to June 1st temperature varied from 101 to 104. June 2nd, blood culture showed staphylococcus aureus. June 3rd, low delirium. June 14th, temperature 100; less irrational. June 19th, temperature had been normal for several days; condition of eyes unaltered. June 20th, grew rapidly worse, pulse became rapid and feeble.

CASE III.—S. R., age forty-one. Admitted November 20, 1916. Died November 25, 1916. Diagnosis: Carbuncle of lower lip. Operation: Multiple incisions.

Present illness started six days ago as a small pimple just below the lip, a little to the right of the median line. Patient picked off the scab and twelve hours later the lower lip began to swell and became red and painful. Family doctor gave her an ointment which did no good; lip became larger and more painful and hot. Patient was unable to talk, eat or sleep. Twenty-four hours ago lip was incised.

General appearance is that of a well-developed and well-nourished woman who seems acutely ill. Pupils react normally; ears and nose negative. Many teeth missing; the rest are discolored, decayed and show extensive pyorrhœa at the roots. Tongue is dry and coated. Lower lip greatly swollen, much thickened and protrudes enormously. Whole lip is a bluish-red color, hot and indurated, and on upper surface shows several pin-point holes oozing pus. Extending down to the thyroid cartilage and equally distant on both sides is a general red, indurated area. Submaxillary glands are enlarged. Physical examination otherwise negative.

Under general anaesthesia wide incisions were made through indurated tissue.

Temperature on admission was 104; second day after operation 105, 106.2; third day 106.2, 107, 107.3, 108.2, 109.2 (died).

CASE IV.—O. McC., age sixty-five. Admitted January 12, 1918. Died January 14, 1918. Diagnosis: Cellulitis of face. Operation: Multiple incisions.

Present illness started four days ago as a pimple on left side of septum. Was treated by physician who pressed out core of abscess, and later swelling of face and present condition resulted. Yesterday temperature was 105. Has had wet dressings on face. Past history negative. There is a slight swelling and redness about both eyes. About mouth, nares and over entire right cheek, as far back as ear and right side of neck, there is a swelling with redness and brawny induration. Upper lip shows several pustules from which pus can be pressed. Especially tender at right side of neck. Examination otherwise negative.

Operation was performed under general anaesthesia. Two linear incisions two inches in length were made in the upper lip and with blunt dissection the surrounding tissue was opened and the incisions were packed. Wet dressing applied.

Temperature on admission 104.5, 104, 105, 104.1, 103.3, 105, 105.1 (died).

CASE V.—A. K., age forty-two. Admitted December 11, 1920. Discharged (cured) December 12, 1920. Diagnosis: Infection of face. Operation: Multiple incisions.

Present illness began four days ago. Patient noticed a small pimple near upper lip. He squeezed it but it gradually got worse, became more swollen and painful. He applied lysol which gave him some relief, but he has been unable to sleep with the pain.

He is a well-developed and well-nourished adult, subacutely ill. There is a diffuse swelling of the upper lip and lateral aspect of the nose. At a point just about

opposite the ala nasi there is evidence of pus about a furuncle which had been scratched by the patient.

Under general anaesthesia an incision one and one-fourth inches in length was made vertically over the most necrotic area; the pus was expressed from the wound. Hot wet boric dressings were applied.

Temperature 101.1, 99.2.

CASE VI.—G. S., age forty-two. Admitted October 28, 1920. Died October 29, 1920. Diagnosis: Furuncle in nose, cellulitis of face, cavernous sinus thrombosis. Operation: Multiple incisions.

Four days before admission patient noticed small pimple just under the nose that seemed to have some pus in it. He opened it with a needle that he had previously run through a flame and squeezed out a small amount of pus. The infection seemed to spread and the next day it was lanced. General signs continued and it was opened again the following day. The day before admission drainage was enlarged, but infection seemed to have increased.

Patient is a well-nourished and well-developed man, acutely ill. There is a marked swelling and oedema of upper lip and nose. On the inside of the right nostril is a spot which appears to be a slough. There is a very intense oedema throughout all the tissues in the face. Physical examination is otherwise negative.

General anaesthesia was used and incision made through the mucous membrane beneath the upper lip, parallel to the teeth line and communicating with the nose. Several punctures were made in the upper lip and the wound packed with iodoform gauze. Wet boric acid pads applied as dressing.

Temperature 102.4, 104.2, 102.3, 103, 105 (died).

CASE VII.—C. K., age twenty-nine. Admitted October 6, 1921. Died October 10, 1921. Diagnosis: Cellulitis of upper lip with cavernous sinus thrombosis. Operation: Multiple incisions.

Present illness began four days ago. Patient picked a boil that was just inside the right nostril. His nose became very sore and about six hours later his sister noticed that his upper lip was swelling. This swelling increased rapidly, passed up the right side of the face until his eye was swollen and closed. He was unable to sleep after swelling began. Previous health had been excellent; had had no serious illnesses, operations or injuries.

Patient is a well-developed and well-nourished man, acutely ill. Upper lip and right side of face markedly swollen and oedematous. On the upper lip, just below the nasal septum, there is a small indurated swelling with a necrotic centre. The lip and right side of the face and tissues around eye are swollen, red and painful. No area of definite fluctuation. The right eye is closed by oedema. Pupils react promptly to light. No derangement of any of the eye movements.

Under general anaesthesia an incision was made in the upper lip, extending from the nasal septum to the vermilion line of the lip and artery clamps were inserted into the deeper tissues in a search for the pocket of pus; no frank pus was found. Rubber dam drain was placed in the wound. Dry sterile dressing applied.

On October 8th a second incision was made over the right temporal region, lateral to the eye, and another curved incision below the right eye. No frank pus was seen. The incisions were packed with plain gauze. Wet dressings applied.

Pathological Findings: The tissues surrounding the right eye were markedly oedematous and the conjunctiva had begun to protrude from the edges of the eyes. There was a slight protrusion of the left eye also. No definite areas of fluctuation could be made out.





FIG. 1.—Condition presented by Case VII, after death. Cellulitis of upper lip, with cavernous sinus thrombosis.



## STAPHYLOCOCCUS INFECTIONS OF THE FACE AND LIPS

Temperature, on admission, 102.4, 104, 103; second day 103, 103.4, 101.3; third day 102.3, 103, 103.2; fourth day 103.3, 104.4, 104 (died).

Autopsy (performed October 10, 1921): The body is that of a large, well-developed white man, aged about thirty years. Rigor mortis slight. Body slightly warm. Marked œdema of face, most extreme of lower lip and orbital regions. Slight exophthalmos of both eyes, more marked on left. Chemosis both conjunctivæ; marked congestion of face, more on right, with purulent dermatitis and probably thrombosed vessels of right supra-orbital and temporal regions, as there are hard, dark purplish nodules in the skin. There are three surgical incisions in the fascia of the face, one oblique one on the upper lip near the middle and two below the eye on the right side. All are unhealed, show indolent, infected edges, but are not actively suppurating.

The right lung is loosely adherent throughout by fresh fibrinous exudate, especially the outer surface of the lower lobe, where there is a large ragged mass of it. On section both lobes are largely filled with large and small infarcts due to septic emboli. Some of these are suppurating, showing small abscess cavities in the centre. The right lung weighs 700 gm. The left lung weighs 650 gm. It shows approximately the same picture as the right, the nodules varying in size from one to three cm. in diameter, all either suppurating or composed of fresh blood clot in the tissues.

On incising the galea and temporal muscle on the right, the muscle is found to contain many miliary abscesses and some hemorrhage. The muscle is also very œdematous and considerably thickened from excess of fluid.

The longitudinal sinus contains a post-mortem clot which is free, leaving the dura smooth and shining. In the anterior fossæ, however, the dura is considerably injected and shows small hemorrhages around the body of the sphenoid bone on both sides of the clinoid processes. The cavernous sinus is thrombosed throughout, being filled with a pale yellowish pink, soft clot which adheres tightly to the walls and extends downward into the basilar plexus and probably the inferior petrosal sinuses. The longitudinal and transverse sinuses are entirely clear, containing post-mortem clots only. The bone itself is not softened; is firm and white when the dura is stripped from it.

The dural vessels are not otherwise noticeably injected. The ethmoid and sphenoid sinuses are lined with pale yellow mucosa, with no evidence of infection or hemorrhage. The pia is considerably injected, but there is no hemorrhage and no evidence of suppuration. Sections of the brain show no lesions. The ventricles are not distended. The choroid plexuses are normal. The pituitary is firm; the stalk much injected.

The fascia posterior to the eyeball shows a few small hemorrhages. Dissection shows the superior ophthalmic veins firm and much injected, thrombosed on both sides, but more conspicuously so on the left.

CASE VIII.—G. W., age sixteen. Admitted January 8, 1922. Died January 10, 1922. Diagnosis: Carbuncle of upper lip; general septicæmia. Operation: Multiple incisions.

Two days ago patient picked small pimple on upper lip. Lip soon began to be red and painful and swelled rapidly and has gradually extended to its present dimensions. Has had high fever and general malaise and one chill this afternoon. Has never been sick before. Face is red, hot and swollen; both eyes are closed on account of the swelling. The upper lip is very red and swollen, showing several small abrasions said to be the original focus. The œdema is brawny over the upper lip.

Multiple incisions were made under general anæsthesia. Temperature on admission 104.2; at time of death 108.2.

Autopsy (performed January 10, 1922): The body is that of a boy aged sixteen. General development and nutrition good. Body cold. Rigor mortis present. Three small incisions five-tenths cm. in upper lid from which purulent exudate and neurotic tissue can be expressed on slight pressure. The tissues of the face are oedematous and the upper lip markedly swollen. The lids of the left eye are slightly swollen. There are no other bruises or marks of external violence.

On opening the abdomen there is no free fluid or other exudate on the right side, but the anterior surface of the stomach, where it is overlapped by the liver, is slightly discolored by brown coffee-ground material. In the left upper quadrant covering the fundus of the stomach and surrounding the spleen is a considerable quantity of semi-fluid, black, sticky material which is evidently stomach contents as a large defect in the anterior wall of the stomach just below the cardia is present. The edges are very soft and break down further readily on pressure. The dissolution of tissue extends into and involves the lower right corner of the left pleural sac and about 500 c.c. of the same fluid are present in the left pleura. The surrounding portions of oesophageal and cardiac wall are not congested, are pale, soft, and show a few prominent vessels, probably thrombosed. The pericardial sac contains the normal amount of clear fluid; the surface is smooth, the left ventricle contracted and the valves show no lesions. The left lung is coated with flakes of fibrin; is studded throughout with many hard hemorrhage nodules, probably infarcts. The intervening tissue is in many areas firm, vascular and granular, due to areas of broncho-pneumonia. The right lung is still more involved, contains a large hemorrhage at the right apex and shows considerable purulent exudate in and around the bronchi of the lower lobe. The surface is also coated with fibrin.

The liver is soft, flabby and much congested. The gall-bladder is normal. The spleen weighs 140 gms., is soft, wrinkled, purplish red, and shows on section loss of markings and much swelling of the tissues.

The kidneys are of normal size; the capsules strip readily. They show acute congestion, but well-preserved markings. The ureter and bladder are normal.

Section of the galea aponeurotica shows marked oedema of the right temporal muscle with some hemorrhage. The dura is intact; the sinuses are not thrombosed. The pituitary shows normal relations and size. The cord is free; the pia arachnoid is free and there is no excess of fluid. There are no gross lesions of the brain demonstrable on section. The ophthalmic veins are not thrombosed.

Anatomical Diagnosis: Carbuncle of upper lip; septicæmia; septic infarction of lungs; acute fibrinous pleurisy; broncho-pneumonia; necrosis of cardiac portion of stomach and left pleura; parenchymatous degeneration of viscera.

Blood culture, January 8, 1922, was positive for *staphylococcus aureus hæmolyticus*.

NOTE.—The histories of two patients with carbuncles of the lips and staphylococci in the blood stream have not been given.

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# HÆMANGIOMAS OF THE GASTRO-INTESTINAL TRACT

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ROKITANSKY asserts that although hæmangiomas are capable of developing after birth they are generally congenital and rarely occur later in life. He holds that many angiomas represent simple hypertrophy of the vascular segments without neoplastic overgrowth. Virchow teaches that the blood-vessels in angiomas develop from sprouts which appear first in the site of preëxisting blood-vessels. He considers the hæmangioma a proliferating tumor, its growth being due to an active irritation which causes the tissues to granulate and results in a rich mass of connective tissue. Trauma at times can be demonstrated as a factor. Thoma refers much of the growth of hæmangiomas to mechanical factors, an increase in blood-pressure and loss of support to vessel walls from changes in the surrounding tissues; this tends to excite a new growth of vessels, while an increased rapidity of flow favors elongation and dilation of the walls.

Hæmangiomas are essentially endothelial tumors composed of capillaries or cavities, or of any gradation between the two. They may be either highly vascular or composed almost entirely of endothelial elements. The capillary type is by far the most important clinically. The vessels and cavities of both types are lined by endothelial cells, usually only a single layer. The walls of the larger vessels are sometimes several cells in thickness. In some hæmangiomas, especially in long-standing processes, there may be comparatively few vessels. Capillaries may have been obliterated and replaced by masses of endothelial cells which have continued to proliferate. This results in characteristic endothelial whorls which are not infrequently accompanied by an overgrowth of fibroblasts. In the majority of cases, the hæmangioma remains local. Complications result from the local condition and are dangerous to the patient insofar as they encroach on vital structures or, by erosion of their limiting walls, cause hemorrhage. At times the growth becomes very extensive. A girl (Case A14928), aged nineteen years, was entirely incapacitated by a tremendous angioma of the urinary bladder; an extension, twelve centimetres in diameter, reached outside the wall of the bladder into the pelvis. The mass was resected and seven years later the patient was entirely well. In a similarly located angioma in a girl of seven (Case A18434), the patient was in no serious danger until the tumor eroded through the rectal wall, shortly after which a hemorrhage resulted fatally.

Metastasis from angiomas is exceedingly rare; there are only a few cases on record. Borrmann cites a case of recurring angioma of the left wall of the chest; the tumor later extended to the lung, causing death by the formation of multiple foci. Ewing describes a somewhat similar case of a bulky cavernous angioma of the skin and mucous membrane which metastasized to the lungs. Shennan reports a case of a girl of twenty-three years with multiple nevi of the skin. She had a history of hæmoptysis and splenomegaly of six years' duration. Death resulted from thrombosis of the mesenteric vessels, and at necropsy multiple angiomatous nodules were found in the spleen, lungs, thymus, and bone-marrow.

Rokitansky, Virchow, and Kaufmann have all said that angiomas of the gastro-intestinal tract are extremely rare. Virchow,<sup>14</sup> in his exhaustive work "*Die Krankhaften Geschwülste*" mentions only one case, an angioma of the jejunum, the specimen of which is in the Guy's Hospital Museum. Kaufmann cites a case of cystic angioma of the rectum.

Patients with hæmangioma of the stomach and intestine not infrequently present alarming symptoms which suggest an unfavorable prognosis, and contrast markedly with the excellent result which may be obtained by surgical intervention. Symptoms may indicate the presence of these tumors since early life. It is only when the tumor reaches such a size as to cause obstruction, or when its presence is revealed by sharp hemorrhages, that these patients seek treatment.

Angiomas of the intestine are rare; they may be multiple and accompanied by similar growths on the cutaneous surfaces. Winternitz and Boggs report a case of multiple angiomas of the intestinal tract, associated with multiple cutaneous angiomas. Gascoyen records the case of a man, aged forty-four years, with numerous nevi in the serosa of the intestine and an angioma of the neck. Angiomas of the stomach are pedunculated and freely movable; they generally occur in the pars media on the posterior wall or greater curvature and are covered completely with gastric mucosa. Ulceration is rare, but when it occurs, it is not infrequently the source of profuse hemorrhage. Very little distress results from the tumor, except that due to bleeding or obstruction. Occasionally these growths attain a large size.

Burty reports the case of a woman aged fifty-eight, who had had moderate pains and a sense of movement in her abdomen for a few months. At operation, a pedunculated angioma two kilograms in weight was found attached to the outer wall of the stomach projecting into the pelvis. A short history of acute symptoms is typical, although in some cases evidence of a tumor may have existed for a long time. Sherrill reports a case of a woman, aged thirty-one, who had a five-year history of decreased appetite and attacks of indigestion with vomiting. Symptoms had started following trauma to the abdominal wall. Pain in the epigastrium was almost constant, and was at times relieved by food. The patient vomited blood several times and

occasionally had tarry stools. Her hæmoglobin was only 30 per cent. A palpable mass, then present in the abdomen, gradually increased in size during the next five years. At operation an angioma with a broad pedicle was found attached to the greater curvature of the stomach. This was removed, together with a portion of the stomach. Gusez reports a case of angioma of the cardiac end of the stomach observed through the œsophagoscope. The patient had lived only on bread and wine for twelve months. There had been no bleeding or emesis. During the last four months he had had extreme difficulty in swallowing. The œsophagoscope was passed and a vascular tumor four centimetres in diameter was found in the cardiac end of the stomach. Treatment by dilatation with bougies and the application of radium gave an ultimately satisfactory result. It is impossible to say definitely that this growth was an angioma, as the diagnosis was not verified microscopically. Stockis<sup>12</sup> found at necropsy a small hæmangioma near the cardia on the lesser curvature of the stomach, in an infant who died following convulsions, shortly after vomiting blood and passing tarry stools. Lammers also reports a case of gastric hæmangioma found at necropsy. The tumor, which was two cm. in diameter and bulged into the stomach cavity, was attached to the posterior wall of the stomach by a broad base. Histologically, it was composed of moderately dilated capillaries, most of which had walls a single cell in thickness.

## REPORT OF CASES

**CASE I (A258233).**—Dr. E. R., aged sixty-seven years, came to the Clinic January 28, 1919, complaining of epigastric distress. Six months before he had had a period of severe diarrhœa with frequent tarry and bloody stools. Following this attack, and again two months before examination, he had had persistent epigastric pain severe enough to keep him awake. A milk diet increased his discomfort, but bismuth gave him relief. During the past six months he had lost twenty-five pounds and felt very weak. His appetite had been good and food gave some relief, although recently eating had produced a sense of discomfort and fullness in the epigastrium. There had been no vomiting or bleeding.

The patient, who was fleshy, had a dilated aorta, and a blood-pressure of 240, was obviously a poor surgical risk. The urine contained a small amount of albumin and the Röntgen-ray revealed a filling defect in the body of the stomach, interpreted as due to a malignant growth of questionable operability. In view of the Röntgen-ray diagnosis, the location of the tumor, the patient's age and hypertension, surgical intervention was not advised. The patient specially requested operation.

A movable lobular mass was found on the posterior wall of the stomach. A sleeve resection was done with removal of eleven centimetres from the middle portion of the stomach, including the tumor. The stomach was closed by an end-to-end anastomosis. Two months later the patient reported his condition to be very satisfactory.

The tumor, six centimetres in diameter, was covered with thinned-out mucosa. On section it appeared blue-black and was divided into small lobulations by septums running in from the surrounding fibrous capsule. The growth was circumscribed and did not project out into the surrounding tissues. Histologically, it was com-





FIG. 1.—(Case A238233). Extensive filling defect on the posterior wall on the pars media of the stomach.

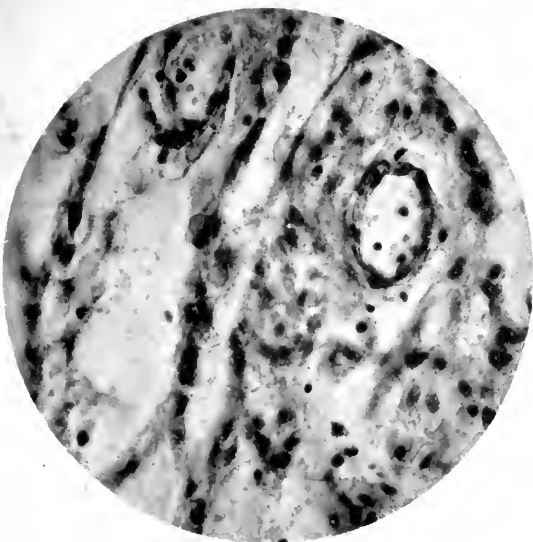


FIG. 2.—(Case A 258233). Interlaced mass of fine blood-vessels, some containing blood-cells. (X200).



FIG. 3.—(Case A 324147). Clearcut filling defect on the greater curvature of the stomach.



FIG. 4.—(Case A 353572). Filling defect on the posterior wall of the stomach.



FIG. 5.—(Case A 345572). Blood sinuses embedded in solid mass of endothelial cells and fibroblasts, located directly below gastric mucosa. (X40.)

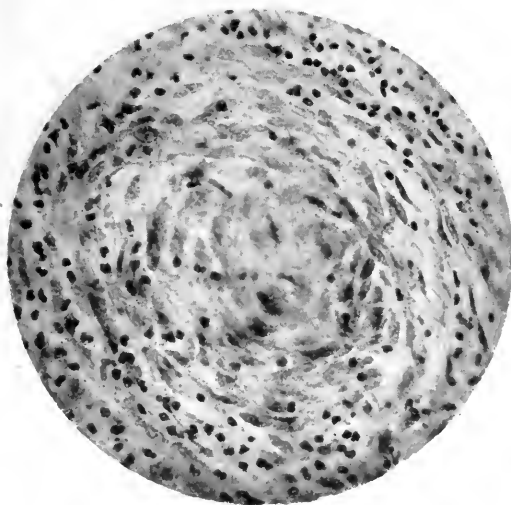


FIG. 6.—(Case A 345572). Extensive proliferation of endothelial cells and fibroblasts following obliteration of capillary vessel. (X250.)

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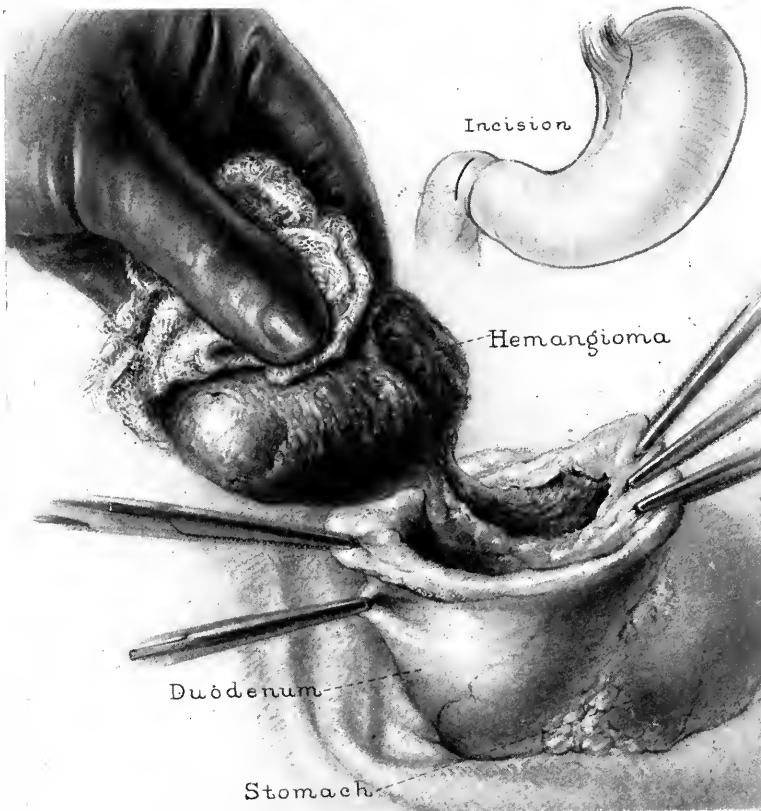


FIG. 7.—(Case 356641). Line of incision into duodenum and removal of angioma together with portion of mucous membrane.

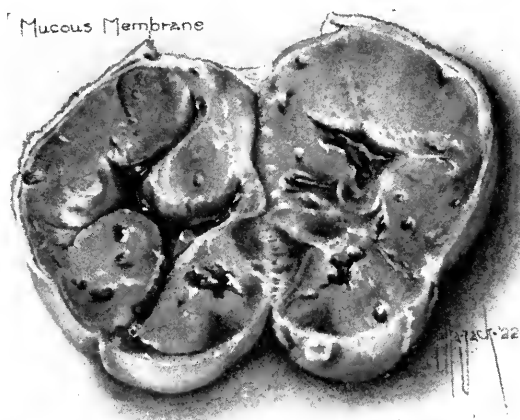


FIG. 8.—(Case 356641). Soft homogeneous structure of hemangioma of duodenum.

posed of multiple capillary vessels, supported by a compact cellular stroma. The vessels were of various sizes, the majority having walls composed of several layers of cells. A few large thick-walled vessels were seen. In most cases the larger vessels and sinuses were filled with red blood-cells. In some areas the vessels and sinuses were in close approximation to one another, with only a few layers of cells between. There was moderate fibrosis throughout, but only very slight formation of endothelial whorls so often seen in this type of growth (Figs. 1 and 2).

CASE II (A324147).—Mrs. H. B. S., aged twenty-five, came to the Clinic July 12, 1920, on account of indigestion which first began six years before. Following the birth of a baby in 1918, the patient had had a period of partial relief. In 1919 her epigastric discomfort recurred. She experienced an almost constant sense of fullness and distress in the upper abdomen. During the past year she had had frequent periods in which her stools were tarry and she had lost twenty pounds in weight. Five months before, and several times since, she had vomited large quantities of blood.

Physical examination was negative and the gastric analysis showed normal acid values. The Röntgen-ray examination revealed a lesion on the posterior wall of the stomach. A diagnosis of benign tumor or gastric ulcer was made.

At operation a smooth, rounded pedunculated tumor was found attached to the posterior wall of the stomach. The area of attachment was excised, two centimetres of mucosa being removed on each side of the tumor, as the stomach was large and sagged considerably. The opening in the stomach was sutured with chromic catgut and silk.

The tumor, two centimetres in diameter, was reddish-blue in color and was capped by a dimpled, eroded tip. It was soft and covered by normal mucosa. The cut section was smooth, vascular and somewhat homogeneous in appearance. Histologically, the most striking feature of the excised tumor was an overgrowth of endothelial cells. There were many small sinuses separated by a few strands of fibrous tissue. From the lining walls of the sinuses, the endothelial cells grew into the lumen in groups and in papillary buds, in some cases to such an extent as to fill the cavity completely. There was only moderate fibrosis and none of the commonly occurring endothelial whorl-formations. It was only on the borders of the tumor that a number of small branching capillaries could be seen. Most of these were composed of a single layer of cells. The fine capillaries served as the centre of the fibrosis which in some instances formed the framework of the larger masses of endothelial cells (Fig. 3).

CASE III (A343572).—Mr. S. S., aged fifty years, came to the Clinic December 13, 1920. For the past year he had been short of breath and had tired very easily, being unable to climb one flight of stairs without stopping to rest. His appetite was good and his bowels were regular. During the past six months he had had occasional attacks of diarrhoea, and vomiting shortly after eating, and had at times experienced a sense of fullness two to three hours after meals.

Physical examination revealed nothing abnormal. The hæmoglobin was 44 per cent., and there were 3,500,000 erythrocytes to the cubic millimetre. The fæces contained blood and pathogenic amœba which probably accounted for the diarrhoea. The gastric contents did not contain free hydrochloric acid and only a small amount of combined acids. The Röntgen-ray examination showed a filling defect in the pars media of the stomach interpreted as due to a malignant growth.

At operation the stomach was found to contain a rounded, movable tumor. A perpendicular incision was made through the wall of the stomach which revealed a pedunculated, elongated tumor arising from the mucosa of the anterior

wall. The base of the tumor and about two centimetres of normal mucosa were excised. The stomach was closed with chromic catgut and silk.

The tumor was sausage-shaped, eleven centimetres by three centimetres. The tip was eroded and ulcerated, which explained the bleeding and anæmia, and very possibly formed the centre of tumor extension. The growth was covered with thinned-out mucosa. Histologically, it was made up of masses of endothelial cells and fibrous whorls; scattered throughout the cellular ground-work were numerous small sinuses and dilated capillaries. Most of these were lined by a single row of endothelial cells with large bulging nuclei. Often these cells budded both into the lumen of the vessel and on the outer surfaces. Very few capillary buds or fine capillaries were seen. The process at the time of removal was apparently of long-standing and quite inactive (Figs. 4, 5, and 6).

CASE IV (A356641).—Mrs. B. C., aged twenty-two years, came to the Clinic April 28, 1921, complaining of chronic dyspepsia since childhood. She was nervous and excitable, and any dietary indiscretion had always produced nausea and epigastric distress. These attacks started with headache and upper abdominal discomfort, generally coming on about two hours after meals and relieved several hours later by vomiting of sour gastric contents. Recently she had several attacks of severe abdominal pain which were preceded by the usual dyspeptic symptoms.

Physical examination was negative. Hæmoglobin was 65 per cent. Gastric analysis revealed normal acid values with hypersecretion. On Röntgen-ray examination, the duodenum was shadowed as a ring with a translucent centre suggesting a polypoid growth. A diagnosis of a possible benign tumor of the duodenum was made.

At operation a thick-walled dilated stomach was found, the pylorus was wide open and on the duodenal side there was a rounded tumor completely filling the duodenum. A transverse incision was made and the tumor exposed. The mucous membrane was incised over the tumor and it was readily enucleated. The mucosa was sutured and the opening in the duodenum closed with two rows of chromic catgut and one of silk.

The tumor was three centimetres in diameter. It was soft and the cut section showed a colloidal homogeneous surface similar to a circumscribed thyroid adenoma of the fetal type. There were several large, thick-walled sinuses in the centre which divided the tumor into lobulated areas. Histologically, the growth was made up of a mesh of fine capillaries with a few dilated sinuses supported in a highly cellular framework. There were great numbers of small vessels which grew at random and had lumina only slightly larger than the width of the nuclei of the endothelial cells composing the vessel wall. Many of these capillaries were filled with erythrocytes. Branching and budding of the vessels were common, many of the short branches terminating blindly. There was very little fibrous or whorl formation; the growth was apparently a rapid and recent process (Figs. 7 and 8).

#### COMMENT

The most striking clinical feature of these cases is the excellent result obtained by surgery, markedly in contrast to the unfavorable pre-operative outlook. In two of these cases the Röntgen-ray examination and the patient's age indicated a malignant lesion in a possibly inoperable stage and location. The general good health of the patient, the normal acid values of the gastric secretion, and good digestive ability indicated the possibility of a benign

## HÆMANGIOMAS OF THE GASTRO-INTESTINAL TRACT

lesion. In two of the cases, the early age of the patient and the long-standing history were also in favor of a non-malignant growth.

A knowledge of these conditions and a differentiation from various clinically similar neoplasms is of distinct prognostic importance.

### SUMMARY

Angiomas of the gastro-intestinal tract are rare and may simulate malignant conditions. When they occur in the stomach, they are generally found on the posterior wall in the common location for malignant conditions.

Similar to other benign tumors of the stomach, angiomas are occasionally found in young persons. There may be no definite gastric upset, the main complaint being weakness and epigastric discomfort. The acid values of the gastric secretion are generally normal and the general condition of the patient is usually much better than that of the patient with a similarly located malignant lesion.

Angiomas of the stomach, while generally small, may grow to a very large size. They are usually soft and covered with mucous membrane. Histologically, they are composed of fine blood-vessels and masses of fibroblasts and endothelial cells.

At the Mayo Clinic three patients with angioma of the stomach and one with angioma of the duodenum have been operated on in the past two years; two of the patients were young, and two were of cancer age. The advanced age of these two patients and the Röntgen-ray findings, similar to those in malignancy, suggested inoperable malignant lesions.

In all cases the tumor was removed and operation was followed by an excellent immediate and late result.

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## MODIFICATION OF THE KADER OPERATION BASED ON THIRTY-TWO GASTROSTOMIES\*

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It is really more the purpose of this paper to bring before the medical profession the increasing demand for gastrostomy and not to emphasize the slight modification of an already existing operation.

The operation of gastrostomy was first proposed in 1837 by Egbert and the first operation is credited to Sedillot who performed it in 1849. The present mortality is 20 to 25 per cent. in malignant cases, and 8 to 10 per cent. in non-malignant cases (DaCosta's Modern Surgery, 8th Ed.).

Gastrostomy is indicated in cases of cancer of the œsophagus, œsophageal stenosis due to compression, cicatricial changes, trauma, perforations and certain malformations of the œsophagus. It has been recommended as a preliminary procedure in œsophageal diverticula and in resection of a portion of the œsophagus.

The choice of time for the performance of a gastrostomy is of importance in that it very greatly influences the prognosis. It should be done before dehydration has manifested itself and while the patient is still able to swallow liquid food. Our two fatalities in the carcinoma cases were practically in a terminal condition from a state of dehydration. When these cases are operated upon before nutrition is absolutely at a standstill and before the patient is calling on his own body for nourishment, we do not believe that the operation affords any great danger.

We have to report thirty-two cases upon which we performed the operation of gastrostomy. These cases are divided into carcinoma of the œsophagus (of which we had sixteen cases); lye strictures (which numbered fourteen); one case of congenital stenosis of the œsophagus and one case of tracheo-œsophageal fistula.

*Method of Operation.*—In carcinoma cases, under local anæsthesia, an incision is made at the upper margin of the left rectus muscle, four inches in length. The stomach is exposed and identified, as the transverse colon presents itself more frequently than the stomach. A stay stitch is placed in the stomach and the stomach drawn through the incision. The level of the cardiac entrance to the stomach is noted and a point to the left of the cardiac entrance is chosen. The stomach wall is divided down to the submucous membrane through a very small incision. The mucous membrane is picked up with a small rat-tooth forceps through this opening. The blood-vessels are ligated before the mucous membrane is divided just large

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\* Read before the Philadelphia Academy of Surgery, March 6, 1922.

enough to admit a 22 French soft-rubber catheter. The catheter is fixed with a number one catgut stitch so that three-eighths of an inch of the catheter is permitted to pass into the stomach cavity. We think the advantages of this very small opening are: prevents hemorrhage, elimination of the hæmostatic stitch layer, it lessens the possibility of leakage of the stomach contents, and prevents regurgitation of liquid around the catheter. One or two purse-string stitches are placed around the tube. From now on the object is to throw a diamond shaped fold of the stomach wall around the tube, the upper and lower points of the diamond toward the greater and lesser curvature respectively, with the tube in the centre of the diamond. Lembert stitches are used so that a small fold is thrown distal to the tube at the points of the diamond which are one to one and a half inches on each side of the tube. As the tube is approached a larger surface is included in the stitch, so that at the level of the tube, the greater area of the stomach is included in the stitch and thrown around the tube.

The wall of the stomach is then attached to the parietal peritoneum. We have found this step necessary as a great many patients after they have been discharged from the hospital permit the tube to remain out too long and it is then necessary to dilate the channel. Such dilatation is effected by passing a probe through the opening and using uterine bougies of increased calibre to bring it up to the proper dimensions. If the stomach has not been fixed to the parietal peritoneum, this is much more difficult. Very often after gastrostomies, even in carcinoma cases when the œsophagûs has been at rest for several weeks, the patients find they can again swallow and abandon the use of the tube.

While the above procedure may not seem to be necessary to the average surgeon who does the occasional gastrostomy, we have found that in the lye strictures, particularly in children where the stomach is found shrunken, it has been necessary to approach the fundus and use the diamond-shaped area in order to get a proper channel for the passage of the tube.

*Post-operative Treatment.*—It has been suggested by some authors that following this operation the patient should not receive any fluids through the gastrostomy tube for several hours. We do not think this precaution necessary. All our cases are fed three or four ounces of salt solution at the time of operation and every three hours subsequent thereto. Beginning the second day, three ounces of peptonized milk are given every three hours. The diet is gradually increased up to twelve ounces every three hours. At the end of the first week thin cereals, mashed potatoes, vegetables (which have been put through a sieve) are forced through the tube with a syringe. The fats are supplied in the form of butter and olive oil. Fruit juices are given daily and sugars are added to such foods as would require sweetening if taken by mouth. It has been observed by many authors that patients who are fed through gastrostomy tubes do not maintain the same degree of nutrition as those who swallow their food. The lack of psychic gastric

secretion has led to the preliminary mastication of the food before introduction through the tube into the stomach. This method is often very repulsive and is not usually carried out.

Dr. William H. Spencer has advanced the thought that the imbalance was due to the loss of saliva. We must realize that the salivary glands secrete from 1500 to 2000 c.c. in twenty-four hours, which are unconsciously swallowed, and which contain a stimulus in the form of a hormone, an enzyme or an activator, and which are entirely lacking in these cases in which complete stenosis is present. This condition has been obviated by the introduction of saliva into the food in the younger cases of cicatricial stenosis and a much more rapid improvement has been noted.

It was also observed that patients with stenosis of the œsophagus expectorate a great deal more than the normal individual. The saliva should be collected in sterile bottles, and the nose and bronchial secretions eliminated as much as possible and oral asepsis maintained in order that no infective material may be introduced into the stomach.

Concerning the tracheo-œsophageal fistula. We have operated upon one case of this type and there are 146 cases in literature. The mortality following gastrostomy in this condition is 100 per cent., the deaths occurring as a result of bronchial pneumonia due to the regurgitation of food through the cardiac opening from the œsophageal fistula into the lungs. From the literature, sixteen of these cases have been operated upon.

I would suggest in all future operations, in order to prevent the regurgitation of food through the cardiac end of the stomach, that the stomach be drawn through the abdominal incision and divided near the cardiac end; the distal or stomach end of the division closed and a gastrostomy performed in the usual manner. Through the open œsophageal end a catheter should be introduced which passes through the cardiac opening of the stomach into the œsophagus. This artificial fistula ought to be made water tight by purse-string stitches around the tube. The object of this tube is, of course, to permit the œsophageal secretions and any secretions that pass the congenital fistula to have a point of drainage. We believe that with this procedure the life of the patient can be prolonged so that reconstruction work can be done upon the fistula.

The mortality of our carcinoma cases is two deaths in sixteen cases. Two deaths, one each in congenital stenosis and tracheo-œsophageal fistula; and no deaths in fourteen cases of lye stricture.

The lye stricture cases were performed under general anæsthesia, although there is no objection to using local anæsthesia, and it is to be recommended in cases of water starvation. The tracheo-œsophageal fistula case was operated upon the second day of life under local anæsthesia, lived several days and died of broncho-pneumonia.

I am indebted to Dr. J. Chalmers DaCosta and to Dr. Chevalier Jackson, upon whose services these cases were admitted to the Jefferson Medical College Hospital.

# **OBSERVATIONS ON THE TREATMENT OF ACUTE PERFORATIONS OF THE STOMACH AND DUODENUM WITH REFERENCE TO GASTRO-ENTEROSTOMY**

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ACUTE perforations of the walls of the stomach or duodenum are usually found in those areas which are the site of election for chronic ulcer. When independent of any foreign body or other traumatic agency the perforations can occur (1) either as part of the biological phenomena of ulcer, or (2) as an independent lesion.

1. In the latter eventuality the perforation, in its cause, mechanism and subsequent history, resembles in all particulars that of an embolic perforation of the appendix. That such perforations do occur in the wall of the stomach or duodenum is amply borne out by surgical experience and the experiences are further corroborated by much experimental work, especially that of Rosenow and others in the elective localization of bacteria in human disease. It is of much interest to note that the percentages of occurrence of the various lesions—and especially of perforations in the stomach, duodenum, appendix, etc.—correspond fairly accurately with the percentage numbers of similar lesions as they occur spontaneously in disease.

In human pathology such acute perforations, when their surgical treatment is followed by recovery, are distinguished by an absence of post-operative symptoms of any kind which ordinarily follow in many of the cases of stomach or duodenal ulcer. In this regard the subsequent post-operative history of perforation resembles that following operation for perforation of the appendix; the recovery is complete and rapid and, except for certain emergencies, such as obstruction, the post-operative period is devoid of any symptoms.

In cases of this kind the absence of symptoms subsequent to operation has important relations to the unimpaired functional capacities of the stomach. In a stomach in which an acute perforation has occurred independently of any preëxisting ulcer I have been several times able to show that after operation all of the gastric functions are within the normal limits. Inasmuch as many of the post-operative symptoms in cases of unperforated chronic ulcer are undoubtedly due to disturbances of physiology for which there has been insufficient compensation, it is only natural to expect in the cases of simple perforation in which no disturbance of function is present or follows subsequently, that no post-operative symptoms of any kind ought to appear.

2. Penetration of the wall of the stomach or duodenum through the base of an old-established ulcer and when the nourishment of the patient is at par, results from the gradual progression of the pathological process and is invariably accompanied by the formation of dense protecting adhesions around the lesion on the peritoneal side of the stomach or duodenal wall which

effectually lead to a safe walling off of the ulcerating and penetrating area and to the prevention of any sudden outpouring of gastric or duodenal contents into the free peritoneal cavity. Cases of this kind are common knowledge to any operating surgeon. They are especially frequent on the lesser curvature and posterior wall of the stomach and the lesions are very apt to become adherent to the body of the pancreas. Penetration of this kind is also common in gastrojejunal and jejunal ulcer; in these cases the penetration may occur into a neighboring hollow viscus, especially the stomach and the transverse colon.

A sudden perforation into the free peritoneal cavity through the base of an old-established ulcer, under the conditions just described, is indicative of a lack of healing power on the part of the individual. I think that such acute perforations are very uncommon in ulcers of the stomach or duodenum; and I believe that the conditions of nourishment, etc., which would be necessary for an acute perforation to occur through the base of an established lesion are most apt to be present in long-standing gastrojejunal and jejunal ulcer.

In some of the cases of old-established ulcer, however, the mechanism of the acute perforation may be independent of the state of nourishment or of the healing power of the individual, and it then is similar to that which causes the occurrence of acute perforation in the absence of any preëxisting lesion. Here, too, it assumes the characteristics of an embolic phenomenon in the base of the ulcerating defect; it occurs during the course of some temporary bacteriæmia the reasons for which may not be clinically apparent and the evidences of which are so transitory as to be undemonstrable.

Acute perforations through the base of an established ulcer are most common because of this embolic mechanism as opposed to any sudden perforation (penetration rather), due to the lack of nourishment and healing power. Perforations by the former mechanism are especially common in ulcers of the stomach and duodenum. The preponderance of this mechanism would also explain the comparative rarity of acute perforation traced to an established gastrojejunal or jejunal ulcer as opposed to perforations in established primary stomach and duodenal ulcers.

In many cases of this kind, which I have been able to study, it was possible to demonstrate that some disturbances of function existed subsequently to the operation which, undoubtedly, were a continuation of similar disturbances which had existed prior to operation. In some of the cases there was a history of previous dyspepsia; in others the perforation was the first symptom. In some, at least, of the latter, symptoms were undoubtedly present which were too slight to make any impression either because of themselves, or because of the hypæsthetic habitus of the individual.

The post-operative histories of these cases are noted by the fairly common occurrence of post-operative symptoms. In the reports of acute perforations of the stomach or duodenum, as ordinarily published, all of the cases noted

as having post-operative symptoms sufficient for further treatment belong in this group. The facts outlined in the previous paragraph furnish adequate criteria for their explanation, either when the symptoms are due to functional causes or when they are due to the persistence of the primary lesion or to the appearance of new ulcerations in the stomach, the duodenum, at the stoma of a gastro-enterostomy or in the jejunum.

There are apparent exceptions that occur in both of these groups. Those in the first group (embolic mechanism without previous ulcer) are easily explainable. On previous occasions I have gone over the etiology of "peptic" ulcer. From all of the available information it seems that acute defects can appear in the wall of the stomach or duodenum in a number of various ways and because of more than one agency. These all have the important characteristic of undergoing a rapid and spontaneous healing. Such acute defects correspond accurately in human pathology to acute perforations occurring in the absence of old-established ulcers. Apparently some of these acute defects can on occasion assume a chronic protracted course and lose their ability to heal; and, while the cause which determines the refractoriness to healing is not known, it is fairly well established that it must be some definite agency which in most of the cases becomes superimposed on the original mechanism of the acute defect. Here we have the explanation for any of the cases in the first group (acute perforations in the absence of any previous ulcer) which subsequently develop symptoms and in which an ulcerating lesion can subsequently be demonstrable at operation or autopsy at the site of the perforation; the acute defect of the perforation loses its ability to heal because of the superimposition of the agency causing "chronic ulcer." It is conceivable, too, that this latter agency may have also been able to have caused the original defect. Under such conditions a case in the first group (embolic perforations in the absence of ulcer) becomes one of the second group (embolic perforations in the base of an established ulcer).

The exceptions in the second group (perforations through old-established ulcers) are explainable on the basis of remissions of symptoms to which chronic ulcer of the stomach or duodenum is notoriously subject.

The dictum that the accident of perforation is a natural form of cure for ulcer of the stomach or duodenum is fallacious; this can be readily inferred from the facts previously outlined. The fact that no post-operative symptoms appear after the successful closure of an acute perforation simply means either that no true ulcer was present but simply an embolic lesion, or if an ulcer were truly present, that the latter was in a stage of remission which, perhaps, was protracted to a longer interval than is usual.

I go over these essential characteristics of perforating lesions of the stomach and duodenum so minutely, because they seem to me to be of great significance in the determination of the proper methods of therapy. It must be apparent to every one that one is dealing here with two distinct lesions (1) A simple acute perforation; and (2) an ulcerating defect in which an acute

perforation is an unlooked-for emergency, even though it be one of the well-recognized phenomena of ulcer. Naturally while the immediate closure of the perforation is the sine qua non of success in either and every case, the advisability of any further addition to this essential is subject to argument, especially when practised in the cases of the first group (simple perforations) as opposed to those in the second group (perforation through an ulcer base).

The one addition to the simple closure of the perforation about which much has been, and is being written and said, is gastro-enterostomy. The best surgical opinion to-day does not consider any other more radical measures as permissible additions to the closure of the perforation. Surgical opinion is practically unanimous in asserting that the addition of gastro-enterostomy is devoid of any additional risk, as far as danger to life is concerned, when the patient is operated upon while still in satisfactory condition. So that in any discussion about the propriety of adding gastro-enterostomy to the closure of the perforation, this factor may be excluded as being a constant.

Much of the discussion concerning the addition of gastro-enterostomy has arisen because of the fact that in a certain number of the cases of acute perforation symptoms occur subsequently to operation which can be directly attributed to the presence of an ulcerating lesion. Arguing from this point it has seemed to some men that the addition of gastro-enterostomy would obviate any of the subsequent trouble. That is the foundation for the practice of doing gastro-enterostomy at the time of the primary operation for the closure of the perforation.

I am quite sure that every one will agree that if one could feel sure at the time the abdomen was open, that the lesion to be dealt with was a simple perforation, the question of doing anything further would not arise, inasmuch as such a lesion has nothing in common with chronic ulcer and no further disability would and need be anticipated. But the trouble is that while in a few cases the distinction can, perhaps, be made, in much the larger number the gross appearances give no inkling of whether the lesion is a simple perforation or a chronic ulcer plus a perforation. One is then in the position where one must say that the lesion which is exposed is not classifiable or one must assume for safety's sake that all of the doubtful cases are probably ulcer cases in which an acute perforation has been superimposed.

Under such conditions it seems to be beyond question that the propriety of doing anything further and the usefulness of the individual procedure chosen—whether it be gastro-enterostomy or any other recognized form of surgical endeavor—must be determined essentially upon the value of the chosen method of procedure as determined beyond reasonable doubt in cases of stomach and duodenal ulcer which are not complicated by the accident of perforation. If the given procedure be useless, or even of doubtful utility for the purpose of cure in unperforated gastric or duodenal ulcer, it stands to reason that it would be equally useless or of doubtful utility when the lesion was complicated by a sudden perforation.

Present-day opinion concerning the value of gastro-enterostomy has under-

gone considerable change. It has come to be recognized more and more that the method is woefully deficient; so much is this so that among surgeons of large experience gastro-enterostomy is avoided as much as possible and other procedures are substituted whenever the lesion and conditions lend themselves thereto. Gastro-enterostomy has fallen to second and even third place in the order of importance.

Present-day methods require other and more extensive procedures the performance of which would not be, perhaps, quite so innocuous of danger when they are carried out under the emergency conditions of an acute perforation. These include resections of various kinds or pyloroplasties. These ordinarily, as indicated previously, are not to be considered as additional procedures to the life-saving closure of the perforation.

In view of all of the facts outlined in this communication it seems to me that the most rational procedure in the presence of an acute perforation is to simply close the perforation. In a certain number this would be all that would ever be necessary. In others a course of medical treatment might be valuable before resorting to any extensive surgical operation. In still others, in which the continued presence or recurrence of post-operative symptoms would make it advisable, further surgical measures could be undertaken in the security of conditions not burdened with the risks of any emergency and with the added advantage of more prolonged pre-operative study and planning. Better and more adequate measures can thus be more securely employed.

A great deal is being said about combining medical and surgical therapy in the treatment of gastric and duodenal ulcer. Perhaps under no other condition of ulcer is this a greater possibility than after an acute perforation. I have made it a custom after closing the perforation to wait just long enough to be sure that the stomach will tolerate small amounts of food. Then the patient is immediately placed upon one of the recognized courses of medical treatment; most often I prefer the old Lenhartz régime from which all meat is excluded. This has given me most satisfactory immediate and late results.



## DUODENAL DIVERTICULA\*

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It is probably true that the great majority of duodenal diverticula give rise to few if any symptoms, and may be looked upon as unusual findings of little clinical significance, encountered in the routine röntgenologic examination of the intestinal tract. Yet it must be evident to every surgeon who has removed one or more of these diverticula that patients suffering from this condition are in constant danger. The walls of most of the pouches, especially if of any size, are composed only of mucous membrane with a thinned-out muscularis mucosa which may or may not be covered by peritoneum according to the location. That perforation does not occur more often is possibly due to the fact that most of them arise from the inner or posterior surface of the gut and are supported by the surrounding structures. There can be but little doubt that in most instances the anomaly is the result of a congenital defect, although a few cases are reported in which the sac formation has developed in the region of an healed ulcer, while still others give a history of trauma. The principal reasons for attributing these diverticula to congenital defects are that they have been found in infants, may be multiple, and are associated with similar changes in other parts of the alimentary tract. One of our cases showed one pouch in the lesser curvature of the stomach, two in the duodenum, and several in the small intestine and colon. The fact that they may be located in any part of the gut wall would indicate that weakened or deficient areas exist in the muscular coat at points other than those through which the vessels or ducts enter and emerge. Duodenal diverticula occur more frequently in women than in men. The average age in Case's<sup>1</sup> series of eighty-five reported cases is given as fifty-six. However, no conclusion can be drawn from these figures as to the probable duration of the symptoms prior to the time the patient consulted the röntgenologist. It would seem from the histories of our cases that they had developed to a sufficient extent to be of clinical importance at a much earlier period of life. That duodenal diverticula occur sufficiently frequent to be of more than passing interest is shown by the fact that röntgenologists of large experience report the incidence of the lesion in from one to two per cent.

The pathology of duodenal diverticula is very much the same in nearly all of the reported cases. They are referred to as thin-walled sacs, pouched or loculated—according to size—composed of mucosa and muscularis mucosa lined with a smooth epithelium which may show, as the result of distention, thinned-out areas, but not usually showing marked inflammatory changes. The muscular coat is practically absent in every specimen. The actual living

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\* Read before the Southern Surgical Association, December 13, 1921.

pathology as seen at operation is very striking. After freeing the sac from the surrounding fat and areolar tissue it will stand out, delimiting itself by the gas pressure from within. As the dissection is continued down to the neck an actual fenestration may be observed in the muscle layer of the gut wall. The arrangement of the structures is comparable to that of a true aneurism in which the intima has herniated through the outer coats of the vessel. The location of the duodenum in relation to the stomach, gall-bladder and pancreas is such that it is not possible to attribute to this anomaly a characteristic group of symptoms. Apparently there is little discomfort of consequence associated with the condition until the pouches reach considerable size and then only when the neck is sufficiently narrow to cause retention. The resulting symptoms would logically be ascribed to the more usual diseases of the upper abdomen, and could be interpreted only in retrospect after the barium meal.

The first indication that the duodenum is the seat of diverticula may be shown by the development of symptoms of an obstructive nature. Those situated in the first portion may at times interfere with the proper emptying of the stomach, in the vicinity of the ampulla of Vater they may cause biliary obstruction by pressure on the common bile duct, while those near the duodeno-jejunal angle may give rise to serious symptoms from pressure in that region. If the pouches become inflamed or rupture from overdistention, or from the presence of a foreign body, the local or general symptoms usual to such accidents will be present. In the type in which the sac retains large quantities of chyme, as shown by the barium meal, there may be periodic intestinal attacks of a toxic nature. Our second case gave symptoms of this sort, while the third presented the typical picture of an attack of acute dilatation of the stomach. A large proportion of the reported cases of duodenal diverticulosis have been situated in the second or descending portion of the gut in the vicinity of the ampulla of Vater. The next most common site is the first portion and the least common the horizontal or third portion. All four cases herewith reported were located in the third portion.

The Röntgen-ray offers the only means for the diagnosis of duodenal diverticulitis, and too much credit cannot be given to röntgenologists for pointing out this lesion and insisting upon its surgical importance. To Case and Cole especial credit is due.

The ideal treatment is complete removal of the sac by a surgical operation. As to whether this treatment should be advised in a given case, or whether it should be handled in a palliative or expectant way, depends upon the symptoms and location of the pouch. In the cases, giving symptoms, which with a fair degree of accuracy may be attributed to the diverticulum, operative treatment is indicated. Should the barium meal demonstrate the presence of a diverticulum in a patient suffering from chronic digestive disturbance, even if a definite lesion is found in the adjoining viscera, the diverticulum should be removed or infolded at the time the accompanying lesion is corrected, provided no distinct contra-indication exists such as inaccessibility

of the sac or poor condition of the patient. In the type of diverticulum with a wide neck, and without retention as shown by the Röntgen-ray examination, in which the findings may be classed as accidental (provided no other lesion is present), the question of operation may be deferred, especially in the aged. As experience is gained in the operative management of this lesion the natural anatomical difficulties encountered in exposing the sac will soon be met. The non-inflamed diverticula are not adherent and with ordinary care can be dissected from the surrounding structures without great difficulty or danger.

In one of our cases the pouch extended down beneath the mesenteric artery and vein, and in another, two pouches arising from the posterior surface of the third part of the duodenum extended to the right, below and posterior to the head of the pancreas. All three were removed successfully. With the aid of the röntgenologist not only the location of the neck, but the course of the pouch can be determined with considerable accuracy. In order to locate diverticula situated behind the peritoneum it may be necessary to freely mobilize the descending as well as the transverse and terminal portions of the duodenum. The pouches arising from the anterior surface or lower border will come immediately into view, but those originating in the upper border or posterior surface may be difficult to locate. The presence of air in the sac aids greatly in their recognition.

The operative procedure best suited for the relief of a given duodenal diverticulum will depend upon the size and location of the pouch. In those of small size invagination is the easiest and safest operation. The larger ones should be excised if possible. Should the lumen of the gut be narrowed to any extent by either of these procedures gastro-enterostomy should be added in the cases in which the diverticulum is situated in the first, second and proximal half of the third portions and duodeno-jejunostomy if in the distal half of the third portion or in the vicinity of the duodeno-jejunal angle. In the cases with obstructive symptoms, either of the common bile duct or gut, in which for one reason or another it is not possible to treat the sac directly, measures best suited to relieve the obstruction should be adopted. It may be necessary to drain the biliary tract by joining the gall-bladder to the stomach or intestine, or to unite the jejunum to the duodenum or stomach. In other words, proper drainage must be provided under any conditions. Fortunately the anatomical arrangement of the viscera in this region is such that this can usually be accomplished.

Four patients with diverticula of the duodenum have come under my care. In three the diagnosis was confirmed at operation. In each instance the lesion was situated in the third portion or at the duodeno-jejunal angle, in the fourth case the diagnosis was based upon the Röntgen-ray findings only. The first patient was operated upon for a supposed penetrating duodenal ulcer, although a duodenal diverticulum had been suggested by Doctor LeWald, the röntgenologist. No ulcer was found. There was general enlargement of the retroperitoneal glands, one of which was removed, showing Hodgkin's

disease. A search of the descending and transverse portions of the duodenum failed to explain the X-ray findings, but upon exposing the gut at the duodeno-jejunal angle a diverticulum about two centimetres in diameter was located arising from the upper posterior wall. No attempt was made to remove the pouch as sufficient pathology had already been found to explain the patient's symptoms. The second case was diagnosed by Doctor Cole as a large diverticulum of the duodenum. The diagnosis was confirmed at operation, and a diverticulum two and one-half inches in diameter was removed from the third portion of the gut. No other lesion found. The symptoms in this case were those of chronic digestive disturbance with acute exacerbations. In the third case, Doctor Imboden made a diagnosis of two diverticula arising from the transverse portion of the duodenum. He also found a single diverticulum high up in the lesser curvature of the stomach and multiple diverticula of the small and large intestine. The patient had suffered from a severe attack of obstruction high up in the intestinal tract. At operation two large diverticula were removed, and the presence of diverticula in the small intestine confirmed. No exploration was made of the stomach. No other lesion present. The fourth case was referred to the hospital for the relief of pain in the right side with the suggestion that the appendix was the cause. Doctor LeWald made the diagnosis of a diverticulum probably located in the terminal portion. At operation the gall-bladder contained a number of gall-stones. The gall-bladder and appendix were removed. A hurried examination failed to locate the diverticulum. As the patient was quite fat and sufficient explanation for the symptoms had been found, it was not deemed wise to prolong the operation further.

*CASE I.—Diverticulum of the Terminal Portion of the Duodenum. Confirmed at operation. Not removed.* S. V., aged forty-two. Admitted to St. Luke's Hospital, March 18, 1920. Transferred to surgical service, March 24, 1920.

*Chief Complaint.*—Vomiting and soreness in region of stomach. Duration, six months.

*Present Illness.*—Patient has had frequent attacks of vomiting coming on from every three to four weeks for the past six months. No relation to eating. No sharp pain but general soreness over the abdomen. Attacks usually last about one week. Appetite poor. Has lost weight and strength.

*Past History.*—Three years ago patient was treated for Hodgkin's disease and apparently was much improved. Family history negative.

*Physical Examination.*—Poorly nourished woman; swarthy type, appearing chronically ill. Examination negative except for tenderness in the right upper quadrant, and an enlarged gland in the right axilla.

*Laboratory Findings.*—Red blood-cells, 3,600,000; hæmoglobin, sixty-six per cent.; white blood-cells, 22,300; morphology, normal.

*Röntgen-ray Examination.*—(Doctor LeWald.) The stomach is markedly ptosed, "water-trap type." The first part of the duodenum is unusually high, extending up as far as the first lumbar vertebra. The greater curvature is four inches below the umbilicus. There is a peculiar shadow to the inner side of the pylorus suggesting the possibility of diverticulum of the duodenum.

Thirty-five minutes. The first and second part of the duodenum unusually prominent, suggesting the possibility of obstruction about the second portion.

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Five hours, thirty minutes. The stomach is empty, also the duodenum, except for a shadow indicating retention in the diverticulum. Confirmatory examination is advisable.

Twenty-four hours. Some of the meal has reached the sigmoid. Traces of the meal remain as far back as the cæcum. The diverticulum of the duodenum is evidenced by a collection of gas.

*Operation.*—March 24, 1920. Pre-operative diagnosis, perforating duodenal ulcer. Post-operative diagnosis, diverticulum of the terminal duodenum. Retro-peritoneal Hodgkin's. Operation: Exploratory laparotomy. Removal of gland for diagnosis.

*Pathological Findings.*—Enlarged glands throughout gastro-hepatic omentum and along mesenteric artery. Stomach and duodenum, first and second portions normal. At the duodeno-jejunal junction a diverticulum was found about two cm. in diameter arising from the upper and posterior wall of the gut.

*Operative Procedure.*—Upper right rectus incision. Transverse and terminal portions of duodenum exposed by dividing transverse mesocolon. Diverticulum isolated but not removed, as sufficient pathology had been found in the extensive glandular involvement to account for the symptoms. Gland removed for diagnosis.

*Pathological Report.*—Hodgkin's disease, mesenteric node. Recovery following operation uninterrupted. Discharged from hospital, April 9, 1920.

CASE II.—*Diverticulum of the Third Portion of Duodenum. Excision.*—F. S., aged fifty-three. Admitted to St. Luke's Hospital, July 13, 1921.

*Chief Complaint.*—Chronic intestinal disturbance. Present illness, duration two years. Periodic attacks of abdominal pain and diarrhœa lasting about one week, coming on about every two months. Stools often contained mucus and blood. Attacks controlled by a restricted diet and large doses of bismuth. Dietary indiscretions seem to be the exciting cause of the attacks.

*Past History.*—Negative except for nervous breakdown two years ago following first attack of diarrhœa.

*Physical Examination.*—Well-developed and well-nourished female. Slight rigidity over upper left quadrant of abdomen. Otherwise negative.

*Röntgen-ray Findings.*—(Doctor Cole.) Type: orthotonic. Peristalsis: three cycle, equal on the greater and lesser curvatures, unobstructed. Systole and diastole shown distinctly. Ileum, jejunum, duodenum and cap shown distinctly. Connected with the descending duodenum is a very large pouch much larger than a hen's egg. This is observed during the early stages of digestion and also at two, six and twenty-four hours, and it is observed to be still filled with barium from the ingested barium meal three days after the administration of the meal, at the time the colon plates were made. It is approximately well filled at this time as it is in any of the plates. This indicates that the opening of the pouch is upward and not downward. The rest of the duodenum is apparently normal. Cap, normal and symmetrical, and corresponds with the pyloric end of the stomach. Sphincter, normal. Pyloric end of stomach expands and contracts in a normal manner.

From a study of these plates I believe one is justified in making a negative diagnosis of cancer or ulcer of the stomach and a negative diagnosis of ulcer of the cap. There is evidence of gall-bladder adhesions involving the cap of upper part of the descending duodenum.

There is a definite evidence of an immense duodenal diverticulum with its opening upward, which accounts for the prolonged retention of barium in this diverticulum. In spite of the fact that the stomach empties itself during the early stages of digestion there is slight retention of barium up to twenty-four hours and I believe that this retention is due to a regurgitation of the barium from the pouch into the stomach.

*Operation.*—July 18, 1921. Pre-operative diagnosis, diverticulum of the third portion of the duodenum. Post-operative diagnosis, same. Operation, removal of diverticulum.

*Pathological Findings.*—In the third portion of the duodenum a diverticulum was located arising from the anterior wall lying partly behind the mesenteric artery and vein. After freeing, the diverticulum measured about two and five-tenths inches in diameter, base three-fourths inch. Walls very thin, apparently composed of mucous membrane only.

*Operative Procedure.*—High right rectus incision. Transverse mesocolon in region of the third portion of the duodenum divided. Diverticulum isolated. Base clamped. Diverticulum excised. Opening in the mucous membrane closed by running purse-string suture of chromic gut, reinforced by two layers of chromic gut. Wound closed without drainage.

*Röntgen-ray Examination—Post-operative.*—(Doctor Cole, November 12, 1921.) A short series of the stomach made immediately and two hours after the ingestion of a barium meal shows the stomach to be of the same size, shape and position as it was at the previous examination. The jejunum, duodenum and cap and even the jejunal-duodenal junction is shown distinctly, much more than it was at the previous examination. There is no deformity of the duodenum in the region from which the diverticulum was removed. The cap, sphincter and stomach are normal. At two hours the head of the column is in the terminal ileum.

*Pathological Report.*—The specimen when received in the laboratory had been distended with fluid and photographed. It is a thin-walled, fluctuating sac with coarse lobulations caused by fibrous bands constricting the surface, but not corresponding to any anatomical structures.

It measures  $4 \times 4 \times 2.5$  cm. in the greater diameters, resembling roughly a triangular pyramid in form. There is a line of over-and-over sutures at the pedicle which now measure  $3 \times 0.5$  cm. The remainder of the surface is smooth, covered with peritoneum, and very delicate and fibrous adhesions. The surface vessels are moderately injected.

On opening the sac the wall is found to be uniformly about one-tenth cm. in thickness, low ridges separating the lobules. The mucosa, which is greatly stretched and thinned, shows a pale velvety surface with unbroken epithelium, but no trace of the normal plicae circulares, although some of the lobulations may have been found by them.

Microscopic sections were made from two areas. They show the same structures, consisting only of mucosa including the smooth muscle fibres of the muscularis mucosæ and the peritoneum. The mucosa as a whole is thinned, due to the chronic distention, and the villi correspondingly flattened, but the epithelium is fairly normal. No ducts of Brunner's glands are found, and as the serosa is applied closely to the muscularis mucosæ none of the glands are seen. The deeper portion shows a slight catarrhal process, distention of the epithelial cells with mucus, and moderate infiltration of the stroma. Lymphoid nodules, normal in type, are present.

*Convalescence uneventful.* Discharged from hospital, August 6, 1921.

November 15, 1921. Patient in excellent condition and is free from symptoms.

*CASE III.—Diverticula (2) of the Third Portion of the Duodenum. Excision.*—K. H., aged thirty-nine. Admitted to St. Luke's Hospital, November 12, 1921. Chief complaint, dull pain upper abdomen, followed by nausea and vomiting.

*Present Illness.*—Eight weeks ago noticed dull pain in the middle of abdomen. This pain gradually increased and was of a spasmodic nature. Attacks coming on every few hours. Forty-eight hours after onset became nauseated and vomited. General abdominal tenderness and distention. This attack of pain continued for

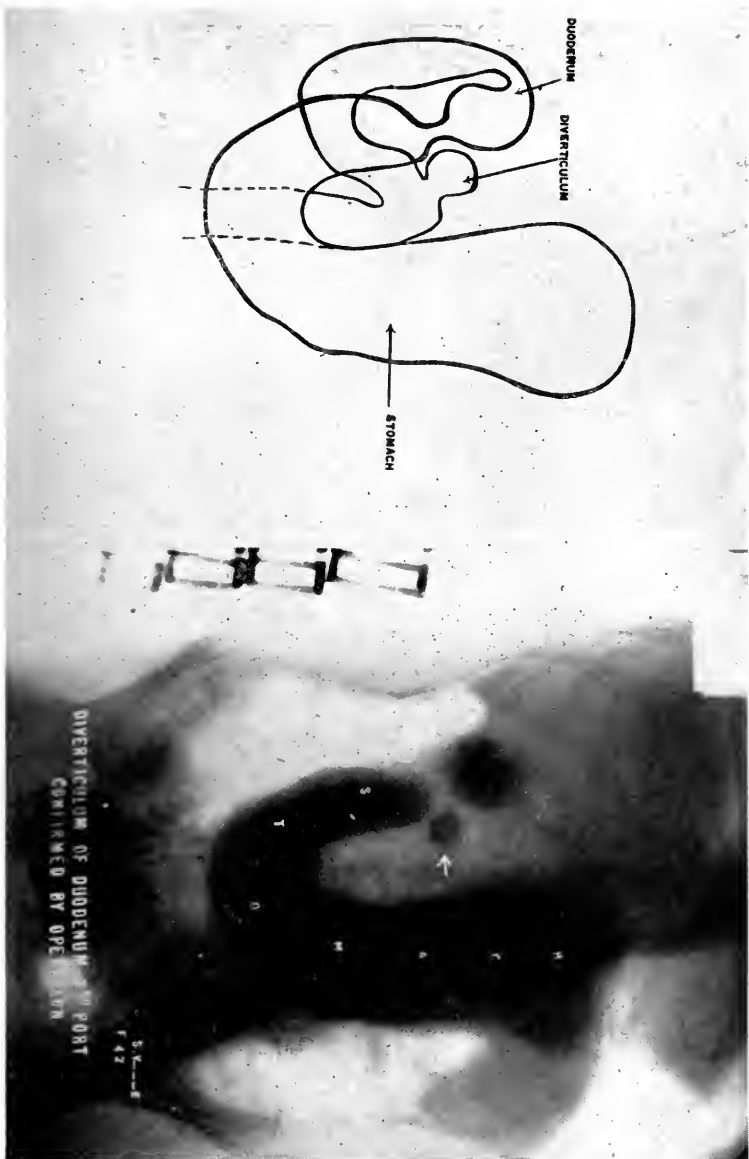


FIG. 1.—Case I. Diverticulum at duodeno-jejunal angle. Confirmed but not removed at operation.

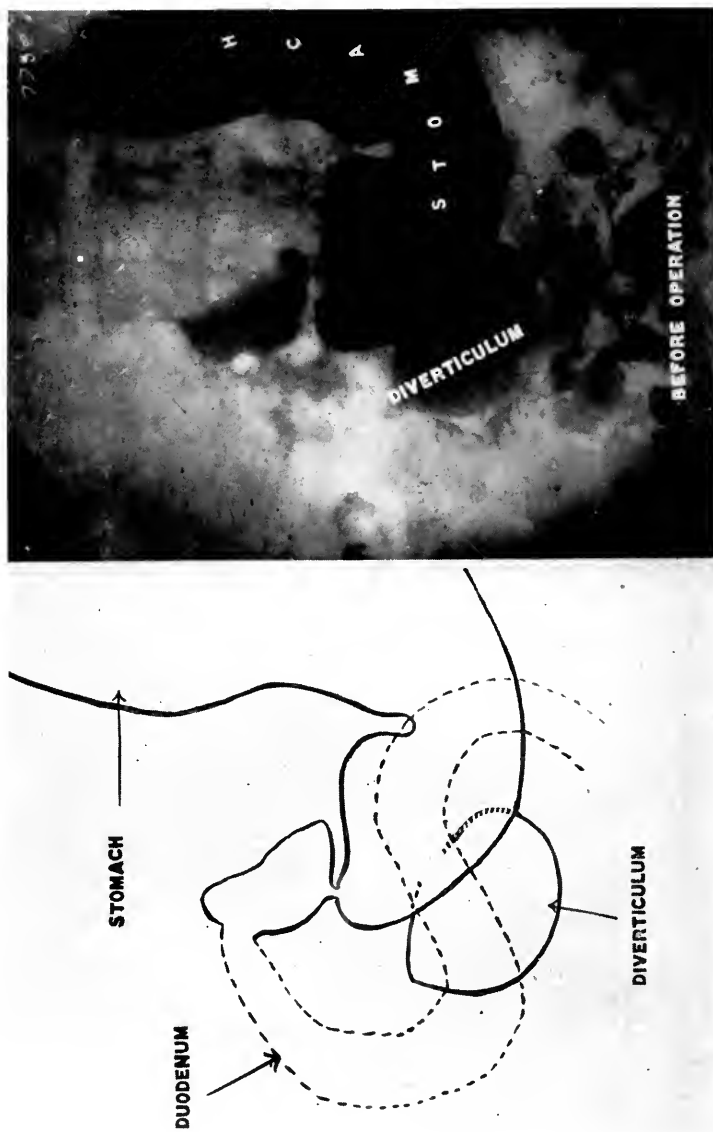


FIG. 2.—Case II. Large diverticulum, third portion of the duodenum. Removed at operation.





FIG. 3.—Case II. Diverticulum of duodenum. Seventy-two hours after bismuth meal. Colon injected.

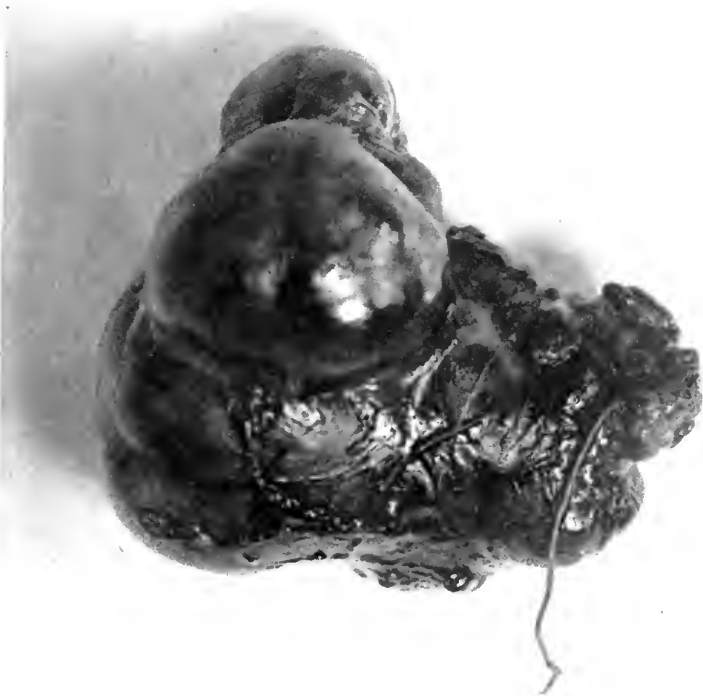


FIG. 4.—Duodenal diverticulum, removed from Case II, July 18, 1921. (Slightly enlarged.)



FIG. 5.—Case II. Three months after operation.



FIG. 6.—Case III. Diverticula (2) third portion of duodenum.

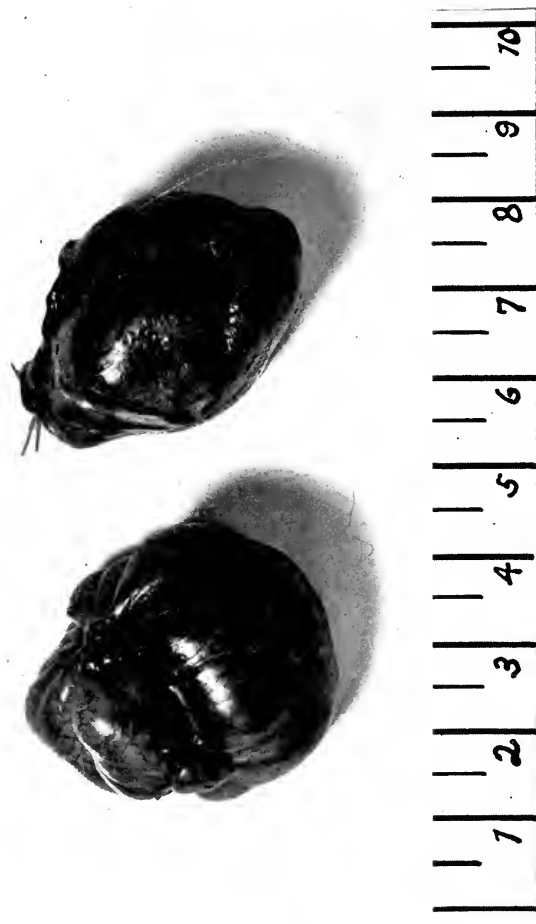


FIG. 7.—Duodenal diverticula. Removed from Case III, November 15, 1921.

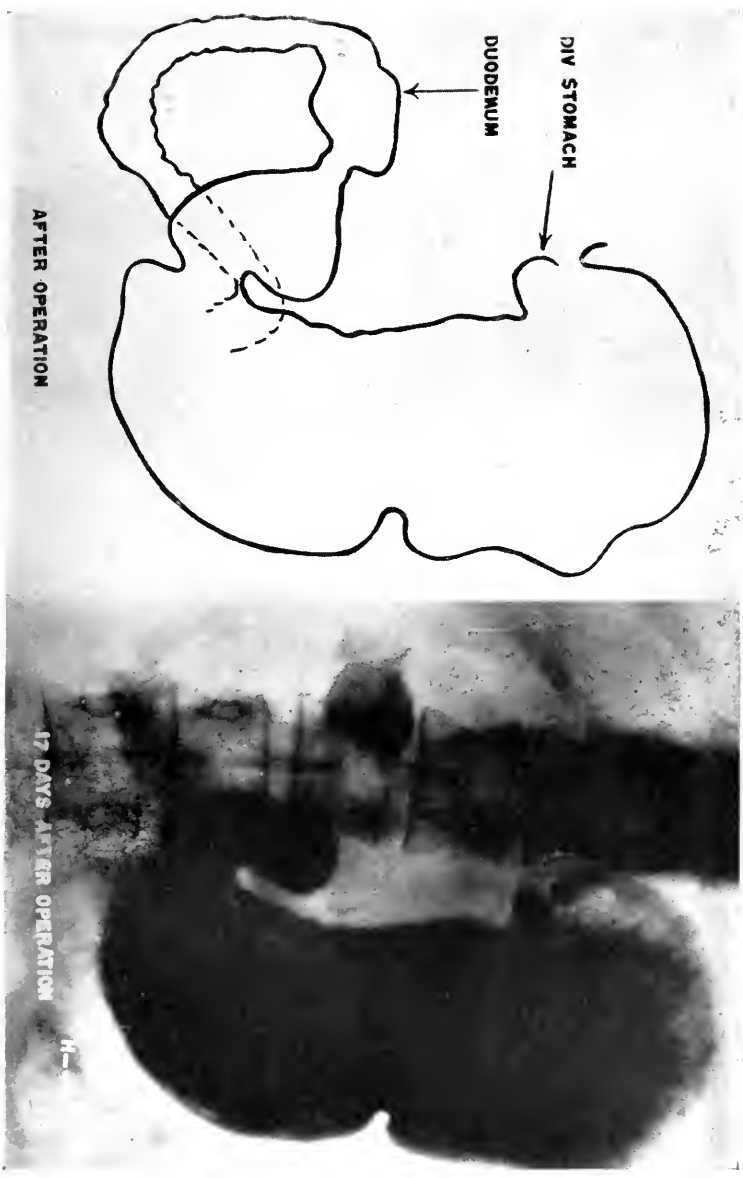


FIG. 8.—Case III. Seventeen days after operation.

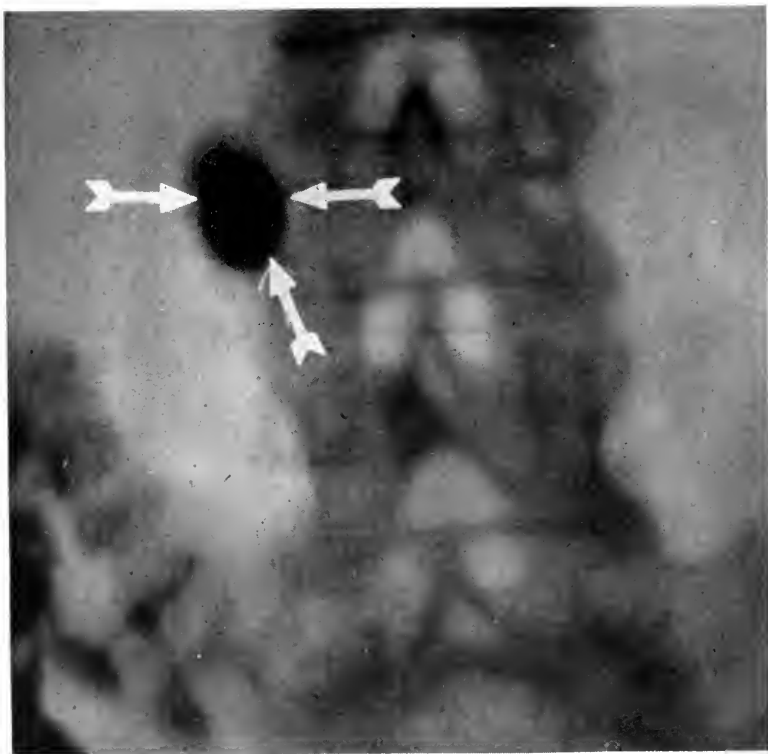


FIG. 9.—Case IV. Diverticulum, third portion, probably at duodenal-jejunal angle.  
Not confirmed at operation.

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eight days and was finally relieved by washing out the stomach. During the attack there was no fever, jaundice or urinary disturbance. Since the attack subsided has felt as well as before attack, except for localized tenderness in the region of the umbilicus.

*Past History.*—Married, four children, no miscarriages. About seven weeks ago had several mild attacks similar to the recent one. Otherwise negative.

*Physical Examination.*—Well-developed, well-nourished woman. There is a slight tenderness in epigastric region—most marked in the ensiform of the middle line. Considerable gurgling in this region apparently due to distended viscera. Otherwise negative.

*Laboratory Findings.*—Red blood-cells, 4,900,000; hæmoglobin, 105 per cent.; white blood-cells, 10,800; polymorphonuclears, sixty; neutrophils, thirty-nine; eosinophils, one.

*Röntgen-ray Examination.*—(Doctor Imboden.) 1. Diverticulum of the cardiac end of the stomach. 2. Large diverticula (2) in the course of the ascending limb of the duodenum which retain the barium twenty-four hours. 3. Small diverticula in the course of the small intestine, ascending, transverse and descending colon.

*Operation.*—November 15, 1921. Ante-operative diagnosis, diverticula of the third portion of the duodenum. Post-operative diagnosis, same.

*Pathological Findings.*—Stomach, gall-bladder, first and second portions of duodenum normal. Two diverticula, one about one and one-half inches, the other about one inch in diameter and about two inches long, were found arising from the posterior surface of the third part of the duodenum. These diverticula extended to the right behind the head of the pancreas, and projected just beyond the right margin of the descending portion. Three diverticula were observed on the convex surface of the jejunum. No further exploration made of the intestinal tract. There was a thick peritoneal band, showing recent inflammation, about four inches in length, extending between the transverse colon and loop of the small intestine.

*Operative Procedure.*—High middle line incision. Transverse mesocolon opened along the third portion of the duodenum and gurgling could be felt upon palpation, but no other evidence of the diverticula could be made out. The second portion of the duodenum was then freely mobilized. The tips of the two diverticula were then recognized and by gentle traction were drawn beneath the descending portion of the gut, and were found to arise from the ascending portion of the third part. The mouths of the diverticula were separated by about one-half inch of normal gut wall. Openings in the mucous membrane closed by running purse-string of chromic gut. Intestinal wall restored by double layer of chromic gut. Peritoneum overlying duodenum approximated with fine gut. Wound closed without drainage.

*Pathological Report.*—Specimen consists of two diverticula from the duodenum. They have been sutured along the cut edges and partially distended with fluid, thus forming two irregular ovoid pouches, one measuring  $3.8 \times 3 \times 3.5$  cm. The other is  $4 \times 3.5 \times 3$  cm. The smaller has the more regular outline, the larger presenting a few coarse lobulations. Both are covered externally with delicate fascial layers. The walls are paper-like in thinness, and in some areas almost transparent. On section they show only faintly the flattened and atrophic remains of the plicæ circulares. The lining is finely granular and appears to consist of mucosa only. Sections of the wall taken from several different areas show that it is composed exclusively of mucosa, being limited on its outer surface by the fibres of the muscularis mucosæ. These muscle fibres are relatively normal, but the remainder of the mucosa is thin and atrophic, the villi are much lower and

more widely separated than normal, and no ducts of Brunner's glands can be found. The epithelium is considerably desquamated from the tops of the villi and the surface covered with a layer of cellular debris and mucus. The tunica propria is hemorrhagic and oedematous, the capillaries contain numerous polymorpho-nuclear cells, and these are also found in increased numbers in the stroma. The entire mucosa is very much injected and penetrated by large thin-walled sinuses.

*Röntgen-ray Examination—Post-operative.*—(Doctor LeWald, December 1, 1921.)

*Stomach.*—The greater curvature is about two inches below the umbilicus. The stomach is dilatated and posed. There is a peculiar pouch-like appearance near the cardiac end of the stomach on the lesser curvature close to the region of the opening of the œsophagus, apparently representing diverticulum of the stomach in view of the fact that there are not active signs of ulcer and no ulcer was found in the stomach at the time of the operation.

One hour, twenty minutes. There is still retention in the pouch at the cardiac end of the stomach. There does not appear to be any areas of retention about the duodenum, at this time, which would suggest diverticulum.

Three hours, fifteen minutes. There is some of the meal in the stomach with retention in the pouch at the cardiac end of the stomach as previously described. There are also some rounded areas in the small intestine.

Four hours, forty-five minutes. There is small retention in the stomach with retention in the diverticulum at the cardiac end of the stomach. The coils of the ileum are prominent and are suggestive in places of adhesions. There is some delay in the ileum.

Twenty-three hours. Some of the meal has reached the rectum. There are traces as far back as the cæcum.

Twenty-eight hours. There is still retention in the diverticulum at the cardiac end of the stomach. Also, there is retention just to the right of the interval between the fourth and the fifth L. V., which represents diverticulum, possibly in the ileum. The cæcum is posed.

Forty-six hours. There is still retention just to the right of the interval between the fourth and the fifth L. V. Also, is a small rounded shadow of opacity just internal to the lower border of the right sacro-iliac joint. Only faint traces of the meal remain throughout the colon.

*Summary.*—Diverticulum of the cardiac end of the stomach. Diverticula of the small and large intestine. Colonic stasis. Convalescence uneventful. Discharged from the hospital, December 3, 1921.

*CASE IV.—Diverticulum of the Third Portion of the Duodenum. Not confirmed at operation. (X-ray Diagnosis.)*—A. LeD., aged thirty-four. Admitted to St. Luke's Hospital, medical service, November 19, 1921. Transferred to surgical service November 25, 1921. Chief complaint, pain in right side.

*Present Illness.*—For many years attacks of pain and tenderness in the right side. No fever, no vomiting. About four weeks ago present attack became so bad had to remain in bed. Pain is greater when standing. Appetite poor. Always has pain in the back. No jaundice. Past History: General health good except for the attacks of pain.

*Physical Examination.*—Well-developed and well-nourished woman. Not appearing ill. Temperature, pulse and respiration normal. Otherwise negative, except for slight tenderness at McBurney's point. Meltzer's test positive.

*Laboratory Findings.*—Negative throughout. Weight, 177 pounds.

*Röntgen-ray Findings.*—Stomach: The greater curvature of the stomach is on a level with the umbilicus. No filling defect is observed in the stomach or



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duodenum. There appears to be some delay in the second portion of the duodenum but this may be due to adhesions.

Fifty-five minutes. The duodenal cap is well filled. The stomach is emptying at a fair rate.

Four hours, fifty-five minutes. There is small retention in the stomach. The head of the column has reached the splenic flexure. No definite delay in the ileum. There is retention in what appears to be the third portion of the duodenum and is probably a diverticulum.

*Summary.*—Duodenal diverticulum. Seventy-two-hour retention in the appendix. Colonic stasis.

*Operation.*—November 25, 1921. Pre-operative diagnosis, chronic appendicitis, diverticulum of the duodenum. Post-operative diagnosis, cholelithiasis, chronic appendicitis, diverticulum of the duodenum. Operation, appendectomy, cholecystectomy.

*Pathological Findings.*—Gall-bladder somewhat contracted, contained numerous fecetted stones. Appendix kinked in proximal portion.

*Operative Procedure.*—Upper right rectus incision. Gall-bladder and appendix removed. Transverse mesocolon was divided over the third portion of the duodenum and a brief search made for the diverticulum shown in the X-ray. As it was not readily found it was not deemed advisable to prolong the operation further.

Convalescence uneventful. Discharged from hospital.

## REFERENCE

- <sup>1</sup> Case, J. T.: Diverticula of Small Intestine, Other Than Meckel's Diverticulum. J. A. M. A., vol. lxxv, p. 1463, Nov. 27, 1920.

## TUMORS OF THE KIDNEY IN INFANCY AND CHILDHOOD \*

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FOUR lesions of the kidney occurring in early life will be considered in this paper, namely, new growth, large solitary or multiple renal cysts, polycystic kidney and congenital hydronephrosis. In general all these conditions may be assumed to be developmental in origin, and inflammatory lesions causing tumor, as, for example, pyonephrosis and perinephritic abscess, will not be touched upon.

Formerly lesions of the upper urinary tract in children have not received the attention they deserved, and in many instances have been overlooked entirely, owing to the lack of refinement of diagnosis. Lately, following modern urological procedures adapted to childhood, many positive diagnoses may be made in conditions that were formerly in doubt. For example, I feel that at the present time no pediatrician should be content with a diagnosis of chronic pyelitis until a röntgenogram, cystoscopic examination, ureteral catheterization and pyelogram have proved that there is no underlying cause for the chronic infection—renal stone may be present; or more frequently a congenital stricture located at one of the four points of election along the course of the ureter may exist, or a band or aberrant vessel at the lower pole of the kidney may be the mechanical factor in the persistence of the pyelitis. Within the year two cases of apparently congenital stricture have come under my care in children of ten years. In one, a girl, the history was a long-standing pyelitis, and a stricture just above the bladder was demonstrated by pyelogram, the ureter above the obstruction being greatly dilated, nearly one inch in diameter. Her stricture is being dilated at the present time. The other, a boy, had attacks of pain in the left side of the abdomen and loin, and hæmaturia since he was two years old. A stricture was found at the level of the pelvic brim, with a ureteral stone acting as a ball valve, and a dilated ureter one inch in diameter ran upward to the kidney. In cases of congenital stricture and hydro-ureter, the ureter has every appearance of the small intestine in the thickness of its wall and calibre.

On the degree of stenosis and the position of the stricture will depend to a certain extent the size of the resultant hydro-nephrosis or hydro-uretero-nephrosis and the location of the tumor. The ureter normally presents three different points of narrowing: at the uretero-pelvic junction, at the brim of the pelvis, and just above the bladder. These appear toward the end of fetal life, become more marked after birth, and persist through adult life. Stricture may occur at any of these points or in the bladder wall, or a part or the whole of the ureter may be replaced by an impermeable fibrous cord. When obstruction is complete either of two conditions may supervene:

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\* Read before the Boston Surgical Society, February 6, 1922.

a very marked atrophy of the kidney may occur, or more commonly, an enormous hydronephrosis results.

Anomalies of the ureter are frequently multiple. Strictures may be bilateral, and this should be borne in mind, as nephrectomy should not be undertaken without ascertaining by ureteral catheterization or by palpation, the condition of the other kidney. There may be complete or partial reduplication of the ureters, and these are frequently the seat of stenoses, or they may end blindly, or be abnormally implanted into the bladder. Not infrequently a bilateral hydronephrosis may be caused by a stricture of the posterior urethra in the region of the verumontanum, where, during normal development, fusion of the two segments of the urethra unite and the velum absorbs. If only partial absorption of this veil takes place stricture results.

Bottomley, in 1910, reported fifty-six cases of congenital stricture of the ureter from the literature. In eight the stricture was at the uretero-pelvic junction, and in thirty-six the stricture was at or near the bladder. In seventeen there was an intravesical protrusion of a blind or markedly stenosed ureter. In 1917 Eisendrath added eleven more cases, including four of his own. Since then several other cases have been reported, notably two by Kakels, in 1918. One was an infant of six weeks with an enormous hydronephrosis containing 900 c.c. caused by an impermeable stricture at the uretero-pelvic junction. The relative size of this tumor can be imagined by the comparison with the normal pelvis of the new-born, whose capacity is one to two c.c. His other case was a hydro-uretero-nephrosis in a ten months' old baby, with a congenital stricture just above the bladder. Both cases were operated on by the transperitoneal route, and he emphasizes the advantages of this method of approach, as giving a far better exposure with a very slight risk of peritonitis.

During the past thirteen years we have had on the surgical service of the Children's Hospital seven definite cases of hydronephrosis from congenital stricture of the ureter. Neither of the cases cited above has been included in this group, as a palpable tumor was absent on clinical examination and as an acquired stricture of inflammatory origin could not be absolutely eliminated, though it would seem highly improbable in either case. The age in four instances was less than one and one-half years; in the others two and one-half years, four years, and eleven years, respectively. Sex was of no importance, three occurring in girls and four in boys. Abdominal swelling was noted in all cases and a definite mass was felt in four instances. Twice the malformation proved to be bilateral, three times it was encountered on the right and twice on the left. Stricture at the uretero-pelvic junction with resultant hydronephrosis the size of a grape fruit or larger was found at operation in four cases. In one child, fifteen months of age, the stricture was in the lower portion of the ureter, probably near the bladder, and the opposite kidney was absent. Ureterotomy was done, the fluid evacuated, and the ureter closed. Death occurred on the sixth day, apparently from peritonitis.

Bilateral hydro-uretero-nephrosis occurred in a girl of two and one-half years who had had attacks of cyanosis for a year and a half and who had had X-ray treatments for enlarged thymus. A severe attack of cyanosis began three days before admission to the hospital and she was brought in in a moribund condition from uræmia. The urine was milky in appearance, the specific gravity 1003, and the sediment contained large quantities of pus. At autopsy the bladder was contracted but both ureters and kidney pelves were greatly dilated in consequence of congenital narrowings above the bladder. In congenital strictures of the ureter of marked degree, the ureters are extremely tortuous as well as being dilated. In this case the child had undoubtedly been hovering on the edge of uræmia, induced by back-pressure and thinning of the kidney parenchyma, and the secondary infection and pyelonephritis caused the fatal termination.

As an example of another type of the malformation, a male infant of three weeks was explored for anuria and abdominal swelling since birth. The abdomen contained a large amount of fluid with a urinous odor. The pelvis of one kidney had apparently ruptured from extreme distention. At autopsy the bladder and urethra were normal and the ureters were patent throughout their length. On both sides, however, the probe was halted at the kidney pelvis. The mucous membrane lining was invaginated into the cavity of the pelvis by the tip of the probe, but no opening existed and there was no escape for the urine to the bladder.

From the surgical standpoint, the cases of greatest interest are those in which a large unilateral cystic tumor exists. Stricture at the uretero-pelvic junction has been the most frequent site of the obstruction in this type of congenital malformation in our experience. Abnormal swelling may have been noted since birth or for only a few days. In one girl eleven years old, the story was of intermittent attacks of pain and swelling in the left side of the abdomen for six years. The child was brought in during an acute attack. A pre-operative diagnosis of ovarian cyst was made. At operation a retro-peritoneal cystic tumor the size of a football was found, identified as a hydronephrosis from the thinned-out kidney parenchyma discovered on its upper pole, and nephrectomy was done. The ureter appeared impermeable and no fluid could be forced out of the hydronephrotic sac after its extirpation.

Of the seven cases in this series, four were hydronephroses of this type. Nephrectomy was done in two instances with recovery. A two-stage nephrectomy was attempted in two instances on account of the rather poor general condition of the child. In one, a subsequent nephrectomy following the drainage of the pelvis, was followed by a post-operative death. In the second, the parents refused to bring the child back for the secondary operation and he was lost sight of with a urinary sinus persisting. Of the two cases with stricture in the region of the bladder, one with bilateral malformations died of pyelonephritis and uræmia without operation. The other, in which one kidney was absent and the other hydronephrotic and badly damaged,

died following a ureterotomy, probably from peritonitis. In this case I believe it would have been better to drain the pelvis and at a subsequent operation, reimplant the ureter in the bladder. In the light of the autopsy findings in the new-born infant with bilateral absence of openings to either pelvis, it would seem indicated, in any case of double congenital hydronephrosis in which a ureter could be found, to open the ureter, and if a lumen was present and the probe passed to the bladder, to attempt a plastic on the uretero-pelvic outlet, which in the above type of malformation would be very simple.

There is little to be said in regard to symptoms and diagnosis. Abdominal swelling is the most constant finding. A cystic tumor when present should suggest the diagnosis from its position, but many times the hydronephrotic sac, though it may be very large, is not tense and may be so flaccid as to be unidentified as a tumor and be mistaken for a general or localized ascites. Unless infected, the urinary examination will be negative. X-ray examination with inflation of the colon would be suggestive evidence here as with other kidney tumors, as the colon is crowded toward the median line. Eisendrath places all cases of congenital stricture of the ureter in one of four classes.

1. Those remaining unrecognized throughout life and are an accidental finding at post-mortem.

2. Those with abdominal tumor, which may or may not be recognized as of renal origin.

3. Cases in which the symptoms are those of infection, either renal or of an intraperitoneal viscus.

4. The class of cases characterized by disturbances of micturition, either frequency or retention. The urinary symptoms of the latter class are caused by the intravesical protrusion, where the stricture is in the bladder wall. This may be so great as to shut off the opposite ureter or even the internal urethral orifice. Intravesical protrusion is frequent in adults, as shown by Bottomley's statistics of seventeen instances of this type in his fifty-six collected cases. An example of its occurrence in infancy is reported by Wason. A ten months' baby dying of uræmia showed at autopsy double hydro-uretero-nephrosis and strictures at the ureter orifices. The bladder was small and the site of each orifice was occupied by a large cystic protrusion. Serial sections cut through the tumor walls and examined microscopically showed minute orifices one-eighth mm. in diameter.

Recognition of this type of obstruction should be accomplished even in infancy. A small nasopharyngoscope can be introduced in the urethra of female infants and the condition determined by direct inspection. In the male urethra, too small for the introduction of this instrument, that is in boys under three or four years of age, if at exploration a dilated ureter is found, a probe should locate the position of the stricture. Where the obstruction is found to be below where the ureter enters the bladder, I believe a suprapubic cystotomy is indicated, the probabilities being that an intravesical

protrusion will be found that can be incised readily. Such a procedure would be far quicker and more simple than a ureteral transplantation where the kidney is not hopelessly damaged.

Nephrectomy is indicated in the large hydronephroses where palpation reveals a normal kidney and ureter on the opposite side. If evidence of stricture is also found on the opposite side, an attempt should be made to establish adequate drainage either by a plastic on the ureter, or by ureteral reimplantation, as there is great probability of an increasing loss of function from back pressure and a subsequent infection in the other kidney as well. The transperitoneal approach is by far the best route to employ in the large congenital hydronephroses of early childhood. The oblique loin incision gives a very inadequate exposure and no data are obtained in regard to the other kidney. There is very slight risk of peritoneal infection, no risk of implantation of disease as in nephrectomy for malignant new growth, and in general children withstand laparotomy very well with the exception of intestinal resection, far better indeed than they do the traumatism incident to removing a large tumor through an inadequate incision.

Polycystic kidney in infancy has little surgical importance save in the differential diagnosis. It has been of rare occurrence on the surgical service, only two cases having been operated on and a third instance of the disease being found in the autopsy records. The latter was a still-born baby with large bilateral tumors, each kidney being filled with great numbers of fine cysts containing watery fluid. Associated lesions were status thymicus, fibrosis of the liver and enlarged spleen. One of the operative cases was an infant of seven weeks with a history of abdominal distention since birth and obstipation. Laparotomy revealed enormous kidney tumors composed of multiple small cysts of varying size nearly filling the abdomen. Death occurred two weeks later. The third case was a boy two years old, who was operated on for left renal stone. Autopsy, following the post-operative death, demonstrated pyonephrosis and infected cysts on the left side and a typical congenital cystic kidney on the right.

Polycystic kidney is a disease encountered at the extremes of life. Many cases have been reported where it was necessary to empty the cysts before delivery of the child was possible, and many others are in new-born infants, as in one of our operative cases. During later childhood and in young adult life cases are rarely encountered, but in the third and fourth decades and later, the majority of cases come to the surgeon for one of three conditions, growth of tumor, hæmaturia or superimposed infection. Uræmic symptoms may be the first sign of disease noted.

Although practically all the kidney tissue may be replaced by cysts and the amount of secreting substance be incredibly small, possessors of such organs may attain adult life without symptoms or knowledge of any kidney disease.

That polycystic disease is always bilateral seems assured from Barnett's

statistics. In his series of 422 collected cases, 291 were described as bilateral, 131 as unilateral. One hundred and four were taken from autopsy reports and without exception were bilateral. In nine of the so-called unilateral cases, nephrectomy had been done. Following these cases up for varying lengths of time, it was found that five of them developed polycystic disease of the remaining kidney. Braasch, in 1916, reporting the cases from the Mayo Clinic, forty-one in number, states that twenty-six were recognized clinically, that tumor was noted in thirty-one cases, but in only eighteen was it described as bilateral before operation. Therefore any diagnosis based simply on the clinical examination is of no value so far as deciding the involvement of one or both kidneys.

Females are more frequently affected, in the proportion of two to one. Other congenital anomalies are often associated, notably harelip, hypospadias and cysts of other organs, especially the liver. Heredity appears to play a definite part in its incidence. Of Barnett's collected cases, fourteen gave a definite hereditary history. The most striking incidence of familial tendency was published by Wobus in 1918.

The mother was of European peasant extraction, twenty-four years old, at the time of her first pregnancy and was in good health previous to, during, and after her pregnancies. The blood Wassermann was negative. First pregnancy May 8, 1908. Male fetus of seven and one-half months. Abortion was necessary on account of the immensely distended abdomen of the fetus which had to be evacuated before parturition was possible. Ascites was present, the peritoneum was greatly thickened and the abdominal cavity was divided into compartments by adhesions. The kidneys were of enormous size from cystic degeneration, and fused at the lower poles. Second pregnancy January 30, 1909. Well-developed male child. The abdomen had to be drained to permit delivery. The kidney tumors were not so large and they were not fused. Third pregnancy, July 4, 1910. Male full term. Again the abdomen was too large to permit delivery. The kidneys were of smaller size. The parietal peritoneum was thickened, but not elsewhere. Fourth pregnancy November 22, 1911. Female child apparently healthy and normal. Spontaneous delivery. The child has weathered several contagions, but is small for age and not robust. Fifth pregnancy August 10, 1912. Abortion at four months. Fetus destroyed, preventing examination. Sixth pregnancy September 4, 1914. Full-term male child. Abdomen not enlarged, child still-born. Autopsy revealed polycystic kidneys. Seventh pregnancy November 25, 1915. Full-term male child, spontaneous delivery, alive and robust. Wobus remarks on the degree of polycystic degeneration becoming less and less with each successive pregnancy, and also on the evidences of fetal peritonitis, apparently not specific, that likewise decreased.

The pathogenesis of the disease is still a question. Many theories have been advanced, but there are four main views that have received the most

attention. The theory of inflammatory occlusion was advanced by Virchow. Atresia of the tubules was produced by irritation by uric acid and lime salts. Later he modified the theory by the supposition of an intra-uterine papillitis with consequent obliteration of the collecting tubules and cyst formation. The second theory is that of new growth, from the histological resemblance of the cystic degeneration to cyst-adenomata as seen in the ovary. A third view is that it is a developmental malformation, and therefore congenital. Cysts result from arrested development and failure of union between glomeruli and collecting tubules on the one hand, and the straight tubules and the pelvis on the other. The embryology of the kidney supports this view in many particulars. Finally combinations of these theories are held by some observers, to account for the sequence of events in polycystic degeneration that may lead into late adult life. Hagner believes that the disease may originate as the result of embryonic malformation and that subsequent neoplastic formation takes place. The interstitial changes from the compression caused by the cysts themselves, still further tend to augment the size of the cysts.

Epithelial proliferation is commonly seen in polycystic disease, and many observers consider it supports the neoplastic theory. McKinlay cites similar proliferation occurring where an excessive amount of work is thrown on the kidney, as in acute nephritis with degenerative epithelial changes. Also the blood of nephrectomized animals injected into normal animals, will cause numbers of mitotic figures and atypical cell structures in the cells of the tubules. He accounts for the increase in size of the tumor when it occurs after several decades by hyperplastic compensatory change in the renal parenchyma being stimulated when the cysts are in sufficient quantity. The lesion becomes a progressive one and cysts lined entirely or in part with high epithelium, even papillomatous cysts, will result from compensatory hyperplasia of the tubular epithelium.

Little need be said in regard to the diagnosis and treatment of polycystic disease in infants. Bilateral renal tumors, accompanied by ascites in which the nodular masses give the characteristic sensation under the palpating hand of a bunch of grapes, are very suggestive of the condition. The urinary examination is generally negative except when secondary infection has occurred. Hæmaturia is not frequent, unlike the findings in those patients at the other end of the span of life who have passed the intervening period of latency.

Nephrectomy offers little and is not indicated in infancy, as the disease is bilateral, although temporary good results have been reported in the infected cases in adults. The Rovsing operation of puncture of the cysts, and combined with drainage in the infected cases, is the only operation indicated. It will many times tide over a uræmic crisis and the renal function will show improvement. It gives good results in checking hemorrhage, though the effect is not necessarily permanent.



Large solitary or multiple renal cysts are apparently more uncommon than the congenital cystic kidney. Morris in an analysis of 2610 autopsies at the Middlesex Hospital, London, found five cases. Barnett in 10,761 autopsy protocols, from large universities in the United States, encountered the polycystic variety forty-one times. Kretschmer, in 1920, collected ninety-nine cases from the literature and added one more, making a total of 100 cases. It is a disease of adult life, only six instances being reported in children of ten years or younger. The lesion is unilateral, a point of differentiation from polycystic kidney. The right side is slightly more often involved than the left. The frequency of occurrence is greater in females than in males.

There are two main theories of the pathogenesis of large renal cysts, that of congenital malformation, and that of retention cyst following obstruction. It seems probable that the majority are retention cysts. Caulk, in 1913, described the pathology of a kidney containing a large solitary cyst. One papilloma was incrustated with salts and a papillitis had been set up. The cyst lay within that segment of the kidney which was drained by the papilla, and he concluded there was obstruction and consequent formation of a retention cyst. Most of the later observers coincide with this view. The cyst is generally situated at the pole of the kidney, the upper or lower pole being affected indiscriminately.

The symptoms are very indefinite. In only two cases has a correct pre-operative diagnosis been made. The diagnosis of a lesion connected with the kidney has been made on numerous occasions, but the true character of the pathology was only demonstrated at operation. The condition has been confused with ovarian cyst, distended gall-bladder, intra-abdominal or mesenteric cyst, and tuberculous peritonitis. Tumor or abdominal fullness, associated with dragging pain in the loin, have been the symptoms most frequently remarked. Hæmaturia is rarely present, the renal function is normal and the urinary examination reveals nothing abnormal in the uncomplicated case. The contents of the cyst is generally of a clear serous character, but it may be urinous, bloody, gelatinous or caseous.

As, in general, the function of the kidney has not been impaired, the treatment should be conservative. The cyst may be enucleated as in Caulk's case, but usually it is too firmly adherent for this procedure. Partial nephrectomy with resection of the cyst is the operation of choice. Nephrectomy may be required on account of the size of the cyst, the largest cyst reported having contained sixteen litres, though the average size has been that of an orange; or bleeding may be so severe following resection as to require the removal of the kidney.

We have had one case of large solitary renal cyst and one of multiple large cysts on the surgical service at the Children's Hospital. A boy of four years was brought to the hospital with acute symptoms of vomiting and abdominal swelling of four days' duration. There were no urinary symptoms. A large mass was palpable in the right side of the abdomen. A diagnosis of probable appendix abscess was made. At operation mul-

tiple large cystic tumors, arising from the lower pole of the right kidney, were found, the total mass being the size of a large grape fruit. The cysts were filled with fluid blood and clots. Nephrectomy was done and the pathological report was "non-malignant cysts, probably arising from a renal anlage." The boy made a good recovery and lived a healthy life for a year and a half, when he died after an acute illness from volvulus around a band of adhesions. At autopsy the left kidney was found to be normal.

The second case was a girl baby of thirteen months. A definite mass and abdominal swelling had been noted for four months. There had been one attack of urinary retention that had lasted twenty-four hours. Otherwise the urinary history was negative. The urinary sediment, however, showed many pus and blood-cells. The child showed evident loss of weight and appeared cachectic. A large tumor was visible and palpable in the right kidney region. It was fairly movable and tense, and a diagnosis of a rapidly growing malignant new growth, undergoing some degenerative softening, was made. An exploratory operation was undertaken and a large solitary cyst arising from the lower pole, the size of a small grape-fruit, was found. Before the cyst was freed, the kidney was not in view and I believed I was dealing with a large congenital hydronephrosis, a condition I had encountered twice before, and on this supposition I did a nephrectomy, the left kidney being normal to palpation. The cyst was filled with serous fluid, and with the exception of the lower pole, from which the cyst sprung, the kidney was normal. The child made an uninterrupted recovery and when last heard from, eight months after operation, was in good health and developing normally. In spite of the presence of blood and pus in the urinary sediment, I feel that, had I known what I do now about solitary cysts of the kidney, I would have done a partial nephrectomy and saved two-thirds of the renal tissue.

In considering the malignant tumors of the kidney, I have included the neuroblastomata of the adrenal, as the location of the primary tumor is in the kidney region, and they can only be differentiated clinically by certain characteristics of the metastases. The kidney is a favorite site for malignancy in infancy and unfortunately its invasion is so silent that it is only the rare exception that comes to the surgeon in any but the most advanced stage.

The frequency and importance of the neurocytoma or neuroblastoma in the tumors of early infancy has only lately been recognized. In 1903 Kretz suggested the origin of certain lympho-sarcomatous tumors of the liver from the formative cells of the sympathetic nervous system, and in 1910 Wright described the histological characteristics and emphasized the importance of this class of new growth. He considers the essential cells of the tumor more or less undifferentiated nerve-cells, or neuroblasts, from the presence of delicate fibrils, the morphology of the cells, and the arrangement in bundles, similar to those found at certain periods in the development of the sympathetic nervous system and in the anlage of the adrenal.

## TUMORS OF THE KIDNEY IN INFANCY AND CHILDHOOD

Clinically the neuroblastoma presents two types. It may occur as a very rapidly metastasizing and diffusely disseminated malignant process in which the primary tumor in the adrenal may be readily overlooked on account of its small size and relatively slow rate of growth. This type may present bilateral tumors of the adrenal. Such a case in a child of two months presented multiple tumors of the buttock, liver and forehead, the tumor in the latter location being the size of a small orange, while the primary tumor, though suspected, could not be palpated and was only demonstrated at autopsy, when masses were found in each adrenal, the larger being the size of a walnut. The other clinical type is where the tumor grows to large size without evidence of metastases and which cannot be differentiated on gross examination of the specimen from embryoma and only the histologic examination will disclose its character.

The other type of malignant disease in the kidney region has been known clinically as sarcoma, but histologically these tumors present nearly every type of cell that one cares to look for, and for this reason the pathological classification has been greatly involved in the past. Tumors that present the same clinical characteristics have been called spindle-cell sarcoma, hypernephroma and even carcinoma, depending on the preponderance of connective tissue, epithelial cells or various other elements in any given section. Smooth and striated muscle, epithelium in cylinders and even rudimentary tubules or glomeruli, cartilage and connective tissue may be present. It is probable that they all arise from developmental remains, and different types of tumors are simply the expression of different degrees of differentiation of the same embryological new growths. For this reason the comprehensive term embryoma, synonymous with mixed tumor, has been applied to these malignant tumors of early childhood.

It is not generally recognized how common malignant disease of the kidney is in early life. In 1914 Loughnane obtained, from the Registrar General's Return of Death, the fatalities from cancer of the kidney and suprarenal capsule in children under fifteen years in England, for the eleven years, 1901-1911, inclusive. There were 430 cases in children under five years, while only 127 occurred between the ages of five and fifteen years. In children under twelve years malignant tumor of the kidney or adrenal was encountered twenty-seven times on the Surgical Service of the Children's Hospital or among my personal records, during the last twelve years. In twenty-three cases a pathological diagnosis was obtained and in the remaining four cases the condition was established by exploration, although no pathological specimen was obtained. No suspected cases that have not been demonstrated by these methods have been included.

In recording malignant tumors of all ages, Albarran and Imbert found that males were attacked more frequently than females in the ratio of three to one. Loughnane found children to be affected irrespective of sex. In our own series of twenty-seven cases, boys were more susceptible in the

proportion of four to three. In striking contrast to the adult, hæmaturia is rare, and there are no early symptoms. Hæmaturia occurred only twice in our cases, and microscopical evidence from the sediment was obtained only seven times. Listlessness, malaise, loss of weight, diarrhoea or constipation, and sometimes vomiting is noted by the parents, but almost invariably the symptom that brings the child to the doctor is abdominal distention or the actual discovery of the tumor by the parents. In other words, there are no early symptoms. Pain or abdominal discomfort was present in fifty per cent. of the cases; usually it is dull and dragging and rarely sufficient to excite suspicion. A slight elevation of temperature from one to three degrees is frequent. In nearly two-thirds of the cases, a month, and frequently much more, elapsed after the onset of symptoms which were manifestations of advanced disease, before the child was admitted to the surgical service. The children with one exception were all under five years of age, the average age of those with embryoma being three and one-half years and those with neuroblastoma being one and three-fourth years. Twenty-three cases were operated on and four cases came to autopsy without surgical interference. Nephrectomy in fourteen cases gave an operative mortality of thirty-five per cent. Nine cases of simple exploration were followed by forty-four per cent. mortality.

Of the nine cases surviving nephrectomy, with one exception all showed rapid recurrence, death occurring in from four months to one and one-half years. It is interesting to note that the single exception differed in no way either clinically or pathologically from the other cases of embryoma. The tumor was of large size and no post-operative radiation or serum were given. The child is alive and well at the present time three and one-half years following nephrectomy.

The average size of the tumor removed at operation was that of a grape-fruit. Once the signs of disease are manifest, the course is very rapidly fatal and the high mortality following both nephrectomy and simple exploration is accounted for by the extreme degree of cachexia in which the patients come to operation.

Of the twenty-seven cases, no pathological report was obtained in four, five were neuroblastomata, one was small spindle-cell sarcoma and the rest were embryomata. The neuroblastoma metastasizes much more freely than the embryoma, the flat bones, liver, retroperitoneal glands and lungs being frequently involved. On the other hand, embryoma tends to recur locally, and invades by extension to the retroperitoneal glands and the peritoneum, and only rarely metastasizes to the liver and lungs. This being the case, it would seem that in the moderately early case nephrectomy with dissection of the retroperitoneal gland bearing tissue, followed by intensive X-ray treatments, should give a fair percentage of cures. As a post-operative measure, we have given X-ray treatments in two cases—Coley's serum in one case and radium in one—and have seen no beneficial effect in any instance. Loughnane's

statistics are far better than ours. He reports thirteen personal nephrectomies with one death, seven and seven-tenths per cent., and seven exploratories with two deaths, twenty-eight per cent. mortality. His late results of nephrectomies are: Result unknown in three cases, four have survived three years or more, two alive and healthy, two years and six months after operation, two died from recurrence within six months and one died of phthisis three months after operation. He believes recurrence is rare after four or five years. Of the thirty-five nephrectomies he collected from the London hospitals, there was over eighty per cent. of recurrences, seventy per cent. occurring within the year.

Stress should be laid on the necessity of an early diagnosis in the malignant tumors of the kidney in infancy. The symptoms are so ill-defined that in all cases of obscure abdominal disturbance, unaccountable malaise, or abdominal fullness, even if no urinary symptoms are present, the kidney regions should be palpated. If a tumor is felt, operation should be advised without delay. If resistance is noted, even in the absence of tumor, an X-ray with air inflation of the colon should be obtained and an ether examination made. The importance of the relaxation obtained by a general anæsthetic in the palpation of suspected deep-seated tumors of infancy cannot be overestimated.

In conclusion, I want to emphasize the frequency of malignant tumor of the kidney region in infancy, the insidiousness of its onset, and the necessity of its early recognition, as the tendency to recurrence is so great that only by its early surgical removal can we hope for a cure.

## INTRAPERITONEAL RUPTURE OF THE BLADDER\*

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OF PHILADELPHIA

IN looking up the literature of rupture of the urinary bladder recently it was found not as abundant as expected. This accounts for the usual brief discussion of the subject in our text-books. In my first operative experience more than ten years ago in the Philadelphia General Hospital, I was surprised by the difficulty experienced in closing the rent in the bladder. Further experience came slowly, and when an effort was made recently to find the record of this case it proved unsuccessful. Memory must therefore be relied on for the important facts connected with it. The surprise experienced in this case was to be explained not only by my individual lack of experience, but by a general inexperience which explains the scarcity of important papers on the subject. With regard to the mortality which still remains high, few probably appreciate that so high an authority as Rivington in his Hunterian Lecture (*Med. Press and Circular*, vol. ii, 1882, p. 434), after a very critical analysis of all the reported cases, could say that he doubted "whether a single unequivocal recovery after intraperitoneal rupture of the bladder has occurred." He says further, "I do not in this age of antiseptics absolutely despair of a time arriving when it can no longer be said."

The essential facts of the above case were as follows: A middle-aged foreigner, not familiar with our language, was admitted with an acute abdomen, and it was not until the abdomen was opened on the same day that an intraperitoneal rupture of the bladder was discovered. The intestines were considerably distended and the exposure of the posterior wall of the bladder was very difficult and unsatisfactory. It contained a rather extensive and irregular rupture. With the poor exposure and the difficulty of seeing and controlling the irregular margins, the placing of the suture was distinctly difficult and the closure imperfect. The particular causes of the difficulty were deficient laxity in the bladder wall and my previous failure to become acquainted with the anatomical features associated. Too much bladder wall was used up in approximating the irregular margins of the rent, so that this first line of sutures could not afterward be turned in by a Lembert suture.

Walsham (*Medico-Chirurg. Trans.*, 1888, lxxi, p. 149), in reporting a case operated on, said "some difficulty was experienced in obtaining a good view of the part (bladder rent) in consequence of the contraction of the recti muscles, the bulging of the intestines into the wound, and the contracted state of the bladder, which lay deeply placed in the pelvis behind the pubis." He employed to advantage a hooking upward of the bladder by an assistant while the rent was being sutured. His statistics appearing only six years

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after Rivington's paper showed an encouraging improvement in the results of treatment. Of his seventeen collected cases in which abdominal section was done, in three the rupture was extraperitoneal, and of these two died and one recovered. Of the fourteen intraperitoneal ruptures, the rent was sutured in eleven and not sutured in three. Of the eleven sutured cases five recovered and six died. Of the five which recovered in only one was a drainage tube employed. In three a catheter was retained in the bladder, though in one of these it was removed two hours afterwards. Of the three cases in which the rent was not sutured, a drainage tube was inserted in all. One recovered and two died. Walsham thought the presence of a catheter was attended by the risk of cystitis and subsequently septic changes in the bladder wound. In reporting a second case in the same journal (1895, lxxviii, p. 273), he again emphasizes the difficulty in closing the rent and the particular advantages of first introducing the upper sutures, tying and using them as tractors, and of using a Smith's rectangular cleft-palate needle for closing the lowest one-fifth of an inch of the rent which could not be reached and secured by the Hagedorn needle employed for the closure of the rest of it. He says that it is from failure to close efficiently the deepest parts of the rent that several fatal results have ensued. Leakage of the bladder from inefficient suture or the giving way of a stitch, occurred in no less than four of the cases collected from the literature and in two was the direct cause of peritonitis and a fatal result.

Jones (ANNALS OF SURGERY, xxxvii, 1903, p. 215) said that the difficulty experienced by Walsham can be obviated largely by putting the patient in the Trendelenburg position, by leaving the ends of each successive suture long and beginning to suture the upper end of the wound. By this means the wound is pulled up within easy reach and each suture below can be placed without difficulty. Many surgeons, however, would probably prefer to avoid thus favoring the extravasated blood and urine passing further upward among the coils of intestine.

The reported mortality of intraperitoneal rupture still remains high. Jones collected fifty-four cases from the literature, of which twenty-six died and twenty-eight recovered (mortality forty-eight per cent). In thirty-two cases published previous to 1893 there were but twelve recoveries (mortality sixty-three and five-tenths per cent.), while in twenty-two cases reported between 1892 and 1903 there were fifteen recoveries (mortality twenty-seven and five-tenths per cent.) The cause of death generally was peritonitis, shock or hemorrhage. Dambrin and Papin (*Ann. d. Mal. Org. Genito-urin.*, Par., 1904, xxii, pp. 641, 721 and 801) say that when the rent is located very low down in the cul-de-sac of Douglas the interference of the loops of intestine makes the closure difficult. Of seventy-eight collected cases of intraperitoneal rupture they found that forty-four recovered and thirty-four died (mortality forty-three and five-tenths per cent.). Of the thirty-four cases operated on between 1895 and 1904, twenty-seven recovered and seven died (mortality twenty and five-tenths per cent.).

My second case was of the same type as my first, but although the obstacles of the first were overcome by care, and a tight closure obtained, this patient also died.

A Russian workman, fifty-six years old, was admitted to the Philadelphia General Hospital, September 30, 1917, with severe pain in the abdomen, high up, and inability to urinate. He lay on his back with his legs drawn up and he was in great pain which was distributed over the whole abdomen and associated with marked tenderness and board-like rigidity. He had been drinking heavily when two days before admission he fell and was afterward unable to urinate. On admission a catheter was passed and about 500 c.c. of cloudy urine was withdrawn. A cystoscopic examination showed no urine escaping from either ureter. On the anterior surface of the bladder was noted what appeared to be an old blood clot. Rupture of the bladder was diagnosed and the patient was soon afterwards operated on through a midline incision below the umbilicus. The peritoneum was much thickened and the intestines distended. There was a ragged transverse opening in the posterior wall of the bladder about two inches long. With considerable difficulty the mucous and muscular coats were approximated by a continuous catgut suture first and then this was turned inward by a similar Lembert suture. A catheter was left in the bladder through the urethra. Fluid injected through the catheter into the bladder did not show leakage through the line of sutures closing the rent. A cigarette drain was placed in the pelvis and brought out of the lower angle of the incision, which was closed around it. On his return to the ward the patient was placed in the Fowler position and Murphy enteroclysis begun. Although at this stage he seemed to be doing well he died a few hours later.

The cause of the high mortality has been frequently discussed, but I have seen no attempt to explain the difficulty in closing the lower part of a rent in the posterior or peritoneal wall. The explanation is anatomical and should be better appreciated so that one may take advantage of the opportunities to avoid the difficulties. Normally, there is little laxity in the bladder wall anywhere. It is adherent to the surrounding structures everywhere, except on its posterior peritoneal surface, very firmly to the prostate and urethra in the male and to the urethra and vagina in the female, more loosely to the pelvic wall in both sexes, to the rectum and seminal vesicles in the male and to the uterine cervix in the female. The laxity of the posterior or peritoneal wall varies much with the capacity of the bladder, from that of the frequently overdistended and atrophied bladder to that of the normal bladder in which there is very little laxity.

When my first case developed signs of peritonitis soon after operation it was concluded that this resulted from leakage of urine into the peritoneal cavity through the poorly sutured rent and that the condition was then hopeless. The following case gave me my first demonstration that free leakage of urine into the peritoneal cavity did not make a fatal termination inevitable.

The patient was a foreman machinist, forty-five years old, with a powerful physique but a sallow complexion. He had been a heavy drinker of alcohol for years but his urine was normal. He was operated on at St. Agnes' Hospital for a direct inguinal hernia on the left side about the size of an orange on September



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10, 1918. A fatty mass was exposed at about the site of the external ring and the hernia, and this was suspected of containing a part of the bladder wall. The bladder and the sac to the exterior of which the bladder is adherent on the inner side were both adherent to the margins of the hernial ring, but the presence of the bladder had not yet been demonstrated. In order to avoid opening the possible protrusion of the bladder a careful search was made for the sac in the fatty mass along its outer side or as far away as possible from the bladder. After a careful dissection a very small sac was opened and a finger passed through it into the peritoneal cavity the finger being grasped by a tight fibrous ring. The fat was then stripped from the small sac to the ring where the sac was tied off by a catgut ligature and cut away. The fatty mass still protruded and was adherent to the fibrous margins of the hernial ring. In order to return the mass into the abdominal cavity a careful search was made to separate it from the margins of the ring without opening a possible bladder protrusion. During these manœuvres a small area of mucous membrane surface appeared in the mass and this could only mean that the bladder had been opened. However, no urine had been detected and it was felt that the peritoneal cavity had been closed off by the ligature and thus protected. It was decided that it would be safer not to attempt further freeing of the protruding bladder from the margins of the hernial ring. The finger was passed through the mucous opening with some resistance and it was concluded that the finger was in the bladder. It was not until the removal of the finger that urine was detected in the wound. Its absence until this time is explained by the tight closure of the fibromuscular hernial ring. The bladder opening was closed by a catgut ligature and the skin wound closed by silkworm gut, a small gauze drain being introduced to the site of the ligatures. The wound was dressed and the patient put back to bed. The after course was interesting and not a little disturbing.

On September 11th, it was noted that the patient had done poorly since the operation, and it seemed evident that the urine was escaping into the peritoneal cavity. The abdomen was rigid and considerably distended and no peristalsis could be heard. There was persistent vomiting and the face had an anxious expression. I concluded that a fatal termination was probably inevitable but took him to the operating room and under nitrous oxide anæsthesia opened the wound and forced a finger into the peritoneal cavity, when a considerable quantity of urine escaped from the abdomen. A large rubber drainage tube was carried by a long forceps to the bottom of the pelvis and brought out the lower angle of the wound which was sutured around it and covered by a gauze dressing. The patient was taken back to bed, placed in the extreme Fowler position and given Murphy enteroclysis. Within twenty-four hours after the drainage tube had been introduced a distinct change for the better had become evident. This improvement continued without interruption. After the introduction of the drainage tube the urine escaped entirely from the wound, none from the urethra.

Under date of September 25th, it was noted that the gradual improvement continued. A small piece of sloughing tissue appeared in the wound and when it was pulled upon, it proved to be a large piece, in all probability a portion of sloughing omentum. A considerable quantity of pus mixed with urine also escaped. On October 6th, the following note was made: Until last night the urine escaped almost entirely from the wound, when an attempt was made to close the sinus temporarily by means of a collodion dressing. It was partially successful, but after this urine coming through the wound was very much diminished and soon almost all was escaping by the urethra. He left the hospital October 11th and returned to work a month afterward. He has since enjoyed better health

than for some time before the operation, but the hernia has recurred to about the same size and its retention by a truss is still troublesome.

At the Northeastern Hospital, on January 21, 1919, on a woman thirty-nine years old, I did a double salpingo-oophorectomy for a chronic purulent salpingitis of about fifteen years duration. Many old and well organized adhesions had to be broken up, those between the sigmoid flexure and urinary bladder being very dense and strong. The danger of opening the bowel or bladder was fully recognized and due care taken but an opening not quite large enough to admit the end of the finger was made into the bladder. Notwithstanding the small size of the opening the edges could not be approximated by sutures because of the lack of laxity in the bladder wall made abnormally rigid by the old inflammatory process. It would have been necessary to mobilize it by separating the lateral walls of the bladder from the adjacent pelvic walls, but in the presence of the infection this was considered inadvisable. Because of the success of free suprapubic drainage in the hernia case just related, it was concluded to afford such drainage without any further attempt to close the bladder rent. With a large drainage tube from the bottom of the pelvis coming out of the lower angle of the abdominal incision and the patient in the extreme Fowler position with Murphy enteroclysis the after course of the case did not seem to be at all threatening. When she left the hospital seven weeks after the operation the urine was still discharging through the suprapubic drainage sinus and this did not cease entirely until about ten months after the operation. She has never complained of any abdominal trouble since leaving the hospital, is now very strong and weighs 239 pounds.

In the following case reported by Flower (*Brit. Med. Journ.*, August 2, 1914, p. 398) free abdominal drainage through the midline incision without closure of the bladder rupture tided the patient over the dangerous peritonitis stage until in a later operation the bladder opening was sutured.

A man, nearly seventy years old, an alcoholic with arteriosclerosis and emphysema, weighing 265 pounds, tripped and fell on his face about nine o'clock one evening. Early on the following morning he was seized with intense abdominal pain and an urgent desire to urinate but repeated attempts to void were ineffectual. At five A.M. on this second day he was catheterized by his physician and a blood-stained urine evacuated. He was transferred in a sitting position to a hospital and taken to the operating room at nine P.M., twenty-four hours after the accident. Rupture of the bladder was diagnosed, but in view of the great weight and bad condition of the patient Flower concluded to merely drain the abdomen thoroughly to relieve the fast spreading peritonitis and tie in a catheter rather than delay by trying to find and suture the collapsed bladder. After opening the abdomen two large tubes were introduced one to the left flank whither the urine was trickling and one down to the bladder. For some hours both tubes drained well, but latterly all the urine came from the pelvic one and next to nothing from the catheter. The patient's general condition improved so much that it was decided to look for the bladder and repair the damage on the fourth day after the first operation. This was accomplished with much difficulty. After much sloughing of skin and fat around the abdominal drainage tubes, abscess of the scrotum and much œdema of the whole scrotum and penis, the patient was discharged six and a half weeks after the occurrence of the rupture.

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### CONCLUSIONS

1. Intraperitoneal rupture of the urinary bladder is infrequent and its literature scanty. Its mortality is still high but has been much improved in the past forty years, before which recovery was almost unknown.

2. The absence in the posterior or peritoneal wall of the normal bladder of a sufficient laxity for easy and secure suturing of a rent in it is entitled to more consideration than it has received.

3. Free escape of urine into the peritoneal cavity through an intraperitoneal rupture, closed poorly by suture or not at all, will not necessarily lead to a fatal peritonitis. Free suprapubic drainage with the Murphy enteroclysis and the Fowler position may lead to recovery.

## THE BONY FEATURES OF POSTERIOR CONGENITAL DISLOCATION OF THE SHOULDER

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*Introduction.*—"It is my belief that there is no such condition as congenital posterior dislocation of the shoulder." This is the opening sentence of A. S. Taylor's recent vigorous paper upon this much debated subject.<sup>1</sup> Taylor voices not merely his own views, but those also of many surgeons who have made a careful clinical search for the condition rather loosely described in my title. The English language is not peculiar in its possibility of shrouding a definite idea in the most misty and obscure of terms. Whereas, at one time the actual clinical condition was no doubt perfectly well understood, its definition in such words has intensified the later misunderstanding especially since we have become much more exacting in the precision with which terms should be employed. My defense for using this title is the simple fact that it conveys efficiently an idea of the subject which I desire to discuss.

Stimson in his work on fractures and dislocations<sup>2</sup> gives an excellent general review of the literature dealing with all varieties of conditions which have been or may be considered under the head of congenital dislocation, and it is therefore quite unnecessary to consider this aspect of the problem afresh. We may group them as true congenital dislocations, posterior subluxations of infancy, dislocations due to paralysis, pathological dislocations and dislocations by deformity. Of the last mentioned, Stimson says:

"Most of the specimens of dislocations by deformity are open to the doubt whether they may not actually be nearthroses following traumatic dislocations, and this is especially true of those in which dislocation is forward. Gurlt<sup>3</sup> describes seventeen specimens concerning which this doubt exists, and I think he might well have added to them several of those which he described as examples of chronic inflammation." \*

It is not my intention to enter the debate concerning congenital dislocation of the shoulder in general nor in particular to champion either the advocates of so-called congenital dislocation (posterior subluxations of infancy and dislocations due to paralysis) supposed to result from nerve lesions in the brachial plexus (see 1) or the supporters of the theory that birth palsy

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\* Gurlt was able to find in the literature only one case of undoubted bilateral sub-acromial "congenital" dislocation, namely that published by R. W. Smith in the Dublin Journ. Med. Sci. and afterwards in his Treatise upon Fractures in the Vicinity of Joints. Gurlt's charmingly clear description of this single case shows that its features were precisely the same as those of our No. 635 (Fig. 2) except that in our No. 635 the scapulæ were of normal size, the muscular attachments typical for age 32, and there was no marked anomaly of the humeral heads (see 3).

is a sequela of "congenital dislocation" (see 4). I desire to focus attention upon certain facts observed in the study of 730 bodies in the dissecting room. These are indisputable and can be readily confirmed as the entire series of complete skeletons of these bodies is preserved along with all necessary data.

It is of course beyond question that one does not see cases of "congenital dislocation" just after birth, and indeed one is fortunate to find them within a few weeks of birth. Even then the radiogram of the area yields but little information since ossification of the glenoid region is still quite imperfect. Stereoscopic radiograms alone could give even the faintest indication of the real condition of the parts. The radiograms published as illustrations by various authors are hopelessly obscure for study of detail and hence they may be passed over without further comment. The fact that one does not meet with cases presenting symptoms immediately after birth naturally cannot be used as evidence that some disability was not already present at birth. Nor, I think, should one confine his attention to the upper end of the humerus; it is my endeavor to show that the abnormal condition may not affect the humerus at all but only the scapula. Taylor<sup>1</sup> quotes Truesdale as denying that there was ever "epiphysial separation of the upper humerus associated with Erb's palsy in his experience." This is a case in point; we should not expect to find violent injuries of this type, and the mere statement of them indicates deviation of attention away from the scapula and towards the humerus.

Now the condition to which I wish to draw attention is not very uncommon and, indeed, in its less marked stages is of rather frequent occurrence. It is an actual deformity of the glenoid region of the scapula in which the dorsal part of the neck never adequately develops, with the result that the glenoid surface looks more backward than usual and the normal head of the humerus bears an abnormal relation to the shoulder contour. The humerus is in no sense of the word dislocated and therefore this is not a dislocation which can be reduced. There are concomitant anomalies in acromion and perhaps in the coracoid which have been erroneously interpreted by previous writers upon the subject. Indeed the features presented by such cases are so definite, whatever the degree in which the anomaly is evinced, that a short description of the bony peculiarities seems to me worthy of record. I have therefore made a careful study of all our material, comprising 730 skeletons, after having previously examined each body upon its admission to the department.

*Characters of Chronic Pathological Dislocation.*—The survey shows that there is a wide and essential difference in the appearance of the bones in the so-called congenital dislocation from that of the bones in pathological dislocation acquired during post-natal life and never reduced. Briefly the characters of the pathological dislocation are those resulting from a malposition of the normal humeral head in relation to the normal glenoid cavity, whereas the features of congenital dislocation are those of malposition of a practically normal humeral head resulting solely from an improperly placed glenoid fossa and anomalous acromion.

To introduce the subject and make the essential difference clear we shall first consider the characteristics of unreduced pathological dislocation. Figure 1 represents such a dislocation of uncertain duration. All such specimens in our collection are examples of the subcoracoid type. In the total of 730 complete human skeletons we find three examples of unreduced subcoracoid dislocation but none of the subacromial type. This is quite important: in the usual museum collections the number of specimens of any given lesion affords no criterion of the real frequency, since there is no evidence of how large a material the examples represent. In order to obtain dependable information upon such points as this we have preserved the entire skeletons of all cadavera which have passed through the dissecting room during the last seven years. Upon the basis of this collection we can state that in the stratum of society which ultimately drifts into the Anatomical Department, there are of subcoracoid dislocation three cases among 489 white males (six-tenths per cent.), no cases among 143 negro males, no cases among sixty-six white females, and no cases among thirty-two negro females. But in the combined total of 730 individuals there is not one instance of pathological subacromial dislocation.

We shall briefly examine these cases as a preliminary to the discussion of congenital dislocation.

The three specimens are listed as follows: Skeleton 274, male, white, age forty-five; left shoulder dislocation. Skeleton 284, male, white, age seventy; left shoulder dislocation. Skeleton 363, male, white, age sixty-four; right shoulder dislocation.

The age at which dislocation first occurred is unknown in any of the cases, but this is quite unimportant. The common type to which all conform is well shown in Fig. 1. The glenoid surface is normal in contour in most of its outline, and in position relative to the body of the scapula and the scapular neck upon which it is supported. The humeral head is entirely normal in all respects except as below. Signs of pathological lesion are seen upon the ventral aspect of the neck of the scapula and upon the dorsal surface of the upper end of the humerus adjacent to the greater tuberosity. It is plain that in these two areas a nearthrosis has been formed consequent to the dislocation of the humeral head from the glenoid cavity. The glenoid margin is slightly encroached upon by the new joint surface, the outline of which is marked on the scapular neck by osteophytic outgrowth. The nearthritic surface is slightly polished in places. The glenoid surface shows some roughening and alteration of texture subsequent to loss of contact with the humeral head. Such alteration of texture is not evidenced in the humeral head itself. There is however a flattened area between the greater tuberosity and the head of the humerus: this is the nearthritic surface. In this case, No. 363, as in No. 284, the humerus shows less effect of the chronic disarticulation than does the scapula. In No. 274 the situation is reversed.

Summing up then the probable course of events in pathological subcoracoid dislocation, we may state that there is at first no malformation of either

FIG. 1.—Stereoscopic view of right scapula and humeral head in the case of male white skeleton No. 363 W. R. U., age 64 years. Note the nearthrosis developed between the ventral surface of the scapular neck and the dorsum of the humeral head adjacent to the greater tuberosity. This is in consequence of chronic dislocation. Note the precise direction in which the glenoid surface (normal except for the nearthrosis) faces and contrast it with the condition shown in Figs. 2, 3, 4.



FIG. 2.—Stereoscopic dorsal view of right scapula and humeral head from male white skeleton No. 635. W.R.U., age 32 years. This is a typical case of bilateral congenital subacromial dislocation of the shoulder. Note the practically normal condition of the humeral head, the almost normal character of the glenoid surface and outline, and the defective development of the dorsal portion of the scapular neck upon which the glenoid surface is mounted. Note also the anomalous curve of the acromion.





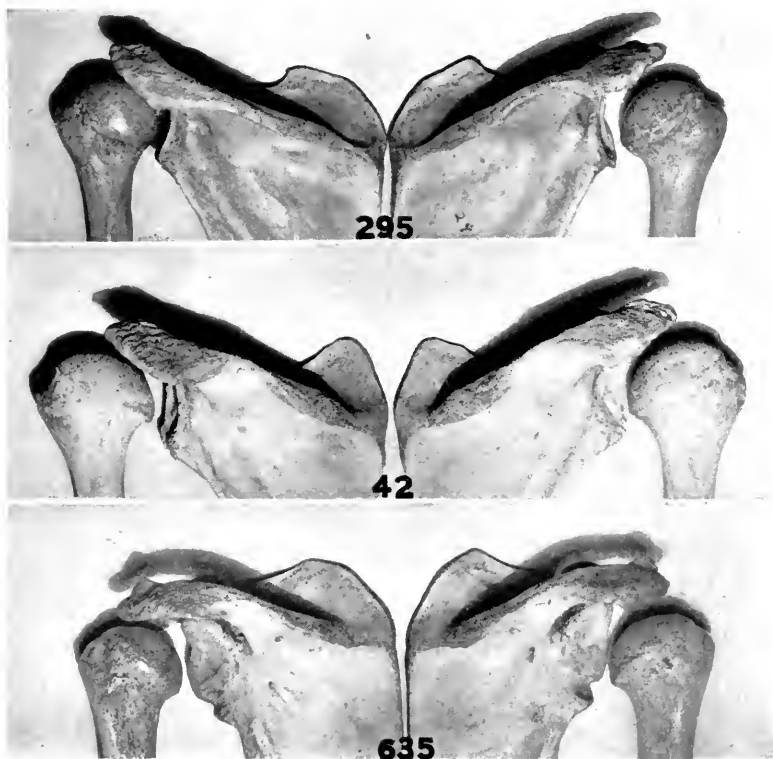
FIG. 3.—Stereoscopic dorsal view of right scapula and humeral head from male white skeleton No. 42, W. R. U., age 38-40 years. The condition of the scapular neck noted in FIG. 2 is present to a mild extent on the right side of this specimen, and to a slighter degree on the left side. Note the consequent backward rotation of the glenoid surface. Note also the slight droop of both acromial processes.



FIG. 4.—Stereoscopic dorsal view of right scapula and humeral head from male white skeleton No. 295, W. R. U., age 41 years. There is slight deformity of the right scapular neck with consequent dorsal rotation of the glenoid surface droop of the acromion. The normal left side may be used as a contrast.



FIG. 5.—Dorsal view of scapulæ and humeral heads of skeletons 235, 42 and 295 to show droop of the acromion as evidenced by its shadow. For full description see legends of Figs. 2, 3, 4.





humerus or scapula, but that the longer the dislocation remains unreduced, both humeral head and scapula become more greatly deformed. The dorsal aspect of the humeral head becomes flattened and a new articular surface develops. Likewise a new articular surface is formed on the ventral aspect of the scapula adjacent to the glenoid fossa, the ventral margin of which becomes excavated. Around the newly formed articular surface there develops an osteophytic ring which gives a secure articulation for the humeral head, maintaining for it a good working socket. Meanwhile the articular surface of the glenoid fossa undergoes changes consequent upon loss of contact with the humeral head.

*Characters of "Congenital" Subacromial Dislocation.*—In "congenital" dislocation, as represented in our collection, we face an entirely different condition. Here the humeral head is not deformed and does not leave the glenoid fossa. The faulty development relates entirely to the scapula.

The first example (Fig. 2) represents the type in skeleton No. 635, W. R. U., male, white, age thirty-two years. This is a case of bilateral congenital dislocation. The humeral heads are normal. They appear very slightly flattened but this flattening is not beyond the normal range. The scapulæ also are normal except for the glenoid fossæ and the acromial processes. Instead of being almost at right angles to the blade of the bone the glenoid fossa is rotated so that it lies obliquely on the dorsum of the blade. There is no anomaly of the glenoid surface itself, and no arthritic change. One might say that the condition has been brought about by failure to develop of the dorsal part of the neck supporting the glenoid surface so that the articular area has been swung backwards. This is, of course, a crude method of stating the case and is not to be taken as a hypothesis upon the actual method of development. It is merely utilized as a convenient mode of expressing the condition. Coincident with the glenoid deformity there is an overhang of the acromion which droops downward over the humeral head. The outer end of the clavicle does not drop, however, and the coracoid is normal: hence the acromion is more tilted than usual and has its dorsal edge on a much lower plane than its ventral margin. Indeed the articular surface for the clavicle is distinctly drawn out and tilted upward as the photograph clearly shows. The precise amount of droop of the acromion is difficult to describe, but is clearly seen in the stereoscopic picture (Fig. 2). Again in the flat photograph (Fig. 5) curvature of the shadow, when compared with that in the accompanying specimens, shows fairly accurately the amount of convexity. I myself as usual examined this cadaver when it first came into the department, made the routine anthropometric measurements and observations, but failed altogether to note any anomaly of the shoulder marked enough to be obvious after death. The clinical history of the case at City Hospital presents no evidence upon the point.

The bilateral nature of the deformity in No. 635, just described, precludes the possibility of its being considered other than congenital. From published records such as those of Thomas<sup>4</sup> to which reference

has been made, it would seem that even bilateral congenital dislocation of the shoulder may occur without causing any marked disability, or, at least, any disability so pronounced as to interfere with the carrying on of the patient's daily work.

The occurrence of Case No. 635 gave a clue to the appearance already noted in two other skeletons the features of which must now be discussed.

Skeleton No. 42, male, white, age thirty-eight to forty years (Fig. 3), represents a lower grade of the same deformity. It is also bilateral, but the deformity upon the right side is greater than that upon the left. Again the humeral heads are normal. The glenoid surface is normal and is only slightly lipped in accordance with the age. Upon the right side failure of the hinder part of the neck to develop fully has resulted in a rotation backward of the glenoid surface. Accompanying this is a small droop of the acromion which is well shown by the character of the shadow (Fig. 5), but which is not sufficient to result in an upward projection of the articular surface for the clavicle.

The left side shows the same condition in still slighter grade. The glenoid surface has a backward tilt only just perceptible and the shadow of the acromion is barely curved.

Skeleton, No. 295, male, white, age forty-one years (Fig. 4), illustrates a condition which would probably have passed unnoticed but for the existence of the two skeletons just described. The left shoulder is normal. One should observe the degree to which the glenoid surface shows (Fig. 4) and the extremely straight shadow of spine and acromion (Fig. 5). On the right side there is very mild rotation of the glenoid surface and a slight curvature of the acromion as evidenced by its shadow.

*Frequency of the Condition.*—From the observations recorded in the above three cases we note that congenital dislocation of the shoulder, of the sub-acromial type, is the result of an extreme mal-development of the scapula whereby the glenoid surface is rotated backward on the blade and that with this there is a drooping of the acromion, but that mal-development does not necessarily occur in the humeral head, which is retained in articulation with the glenoid surface. The mal-development does not always occur in high grade as evidenced by Cases 42 and 295 and moreover may be confined to one side only. The condition has nothing in common with any form of pathological dislocation in which the humeral head leaves the glenoid fossa.

As regards frequency of glenoid mal-development, it may be stated that these three cases represent a survey of 730 skeletons. The three are all white males and in the collection examined there were 489 white males. No case was found in the examination of sixty-six white females, 143 negro males, or among thirty-two negro females. It is also worth recording that in this total of 730 skeletons no case of congenital dislocation of the femur or radius was discovered.

## DISCUSSION

There are several suggestive points in this discussion which should receive brief notice.

In the first place it is not incomprehensible that a deformity such as I have described should be associated sooner or later with a nerve lesion. The head of the humerus is not in the glenoid socket; there is no glenoid socket in which it could lodge but merely a glenoid surface; the humeral head is more mobile than usual and the shoulder posture is abnormal. I have already shown in a previous communication to the *ANNALS OF SURGERY* how faulty posture of the shoulder may act as a causative factor in a nerve lesion of the brachial plexus.<sup>6</sup> It is not necessary to dwell further upon this point at the moment.

Secondly, one may question the real congenital character of the condition. This is done genuinely enough, but the question itself implies imperfect acquaintance with the principles of skeletal formation. We are gradually emerging from total ignorance of these principles though much light is still necessary upon the subject. W. W. Graves, whose scapular studies are well known, has examined and studied in detail the scapulæ of our entire series<sup>6</sup> and has allotted them to his different types. I use the word types advisedly. We are still in the habit of using the term *variation* quite loosely. To quote a recent address by Bateson<sup>7</sup>: "It had been decreed that when varieties of a species coexist in nature, they must be connected by all intergradations, and it was an article of faith of almost equal validity that the intermediate form must be statistically the majority, and the extremes comparatively rare." This kind of fallacious reasoning has been combated by Graves for a decade and yet there are those who, largely in ignorance, seek to maintain that one of Graves' types of scapula can become transformed into another during life. The same unfortunate reasoning is utilized by those who affirm that such scapular forms as are exemplified in Fig. 2 may be the result of acquired conditions during life. Fuller knowledge of the skeleton must finally dispel this assumption already clearly unwarrantable. It is useless to protest that the condition need not have been present at birth. The scapular studies by Graves show conclusively that the form of the scapula is predetermined before ossification takes place. In No. 635 we have not a dislocation it is true, but we see a condition, undoubtedly congenital, in which the head of the humerus is equally certainly posterior.

The third problem is to pick out of the literature those cases which plainly belong to this category. As I have said, the radiograms published convey so imperfect a picture that they are useless. We must therefore depend upon features cited by the author. I do not here propose to analyze all the literature but will content myself with two references. Usually one finds merely the barest indication of what the pathological condition actually was, even if operation was performed. For example, in his first communication Peckham states,<sup>8</sup> referring to his Case I, that the head of the humerus refused to stay in the socket and that no examination of the glenoid was

made with the finger, yet the glenoid was "apparently normal." I doubt very much if this glenoid was actually normal, but can make nothing out of the published radiogram. In his second communication Peckham's<sup>9</sup> case appears to have had some flattening of the humeral head and some slight curving of the acromion, but the glenoid itself does not impress me as deformed.

Turning from these cases to those cited by Thomas,<sup>4</sup> we note two very significant and careful observations which to my mind point indubitably to the fact that Thomas was dealing with instances of true congenital posterior "dislocation." The first is the boy of seven and a half years who presented himself in 1910. "Operative reduction of the dislocation," confesses Thomas (4, p. 208), "was not completely successful. . . ." This is exactly what one would expect in operative treatment of the condition. The other case is that of the orthopædic surgeon (4, p. 211), who showed a "marked bending downward and forward of the acromion." In brief, it is the associated anomaly of the acromion which must be our best guide to the condition clinically and in searching the literature.

#### SUMMARY

Posterior congenital "dislocation" of the humerus, as illustrated in the Hamann Museum at Western Reserve University, provides the following information:

1. It is of the subacromial type and differs from pathological dislocation in the fact that the humeral head never leaves the glenoid surface.

2. It results from a mal-development confined to the scapula and not affecting the humeral head. The mal-development is in the dorsal part of the scapular neck, so that the glenoid surface is rotated on to the dorsum of the blade. Accompanying this is a drooping of the acromion over the shoulder.

3. Congenital "dislocation" is a high grade of the deformity just described, which, however, may be of slight development and unilateral or bilateral.

4. The condition was found in three white males only among a random sequence of 730 complete human skeletons distributed as follows: 489 white males, sixty-six white females, 143 negro males, thirty-two negro females.

5. In the collection just mentioned there is no case of congenital dislocation of femur or radius.

6. Posterior congenital dislocation of the shoulder is not a true dislocation since the humeral head never leaves the glenoid surface. It is undoubtedly "posterior" and all the evidence goes to show that it is really congenital in occurrence since it makes its appearance coincidentally with the original scleroblastic formation of the scapula.

7. There is no inherent reason why this postural deformity should not be associated sooner or later with a nerve lesion.



## POSTERIOR CONGENITAL DISLOCATION OF THE SHOULDER

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## FRACTURES OF THE CAPITELLUM AND TROCHLEA

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FRACTURES of the articular processes of the distal end of the humerus are quite uncommon. A search of the literature reveals only seventeen cases. These include fractures of the whole or part of the capitellum, of the upper portion of the trochlea, and of the capitellum and the trochlea together. The lesion is simply a splitting off of the articular face of the bone by a fracture through the cancellous bone, the fragment consisting only of the articular cartilage and a thin strip of underlying bone. The fracture is intra-articular and the fragment lies free in the joint. The mechanism of the fracture is not definitely known, but from an analysis of the case histories it would appear that the fracture is caused by one or two mechanisms: first, by a blow on the upper end of the dorsum of a partially flexed forearm, transmitting the force through the articular end of the ulna and the head of the radius to the capitellum and trochlea; second, by a fall on the extended forearm, the force being transmitted through the long axis of the radius and ulna in such a way that the head of the radius separated the articular cartilage of the capitellum, the coronoid process acting in the same way upon the trochlea. That the radius may impinge upon the capitellum has been shown by Wilms,<sup>1</sup> who found a depression in the capitellum, which was made by the head of the radius.

The fragment is, as a rule, displaced anteriorly, within the capsule to the front of the humerus so that the fractured surface of the fragment is in contact with the humerus and the articular face points outward or anteriorly. In a case of Flint's,<sup>2</sup> however, the fragment lay against the side of the head of the radius and the outer surface of the capitellum. The fragment may also be displaced posteriorly, remaining still within the capsule. Kocher,<sup>3</sup> in his monograph, "*Fractura Rotuli Humeri*," reports four cases, in three of which the fragment was found to lie posteriorly but still within the capsule. Two cases reported by Lorenz<sup>4</sup> were similarly displaced posteriorly. In the remaining fifteen cases included in this analysis, the fragment was displaced into the anterior recesses of the joint, and in eight of these bony union had occurred between the fragment and the humerus.

The first case on record was described by Hahn<sup>5</sup> in 1852. A woman of sixty-one years of age fell, striking on the hand and extended forearm. There was extensive swelling of the elbow joint, pain on motion, but no change in the normal landmarks of the elbow. Because of the unusual clinical features the case was followed, and four years later the specimen was obtained at autopsy. Dissection showed a fracture of the capitellum, anterior displacement, and bony union with the humerus.

Kocher in the description of his four cases called attention to the clinical finding of crepitus, and that in posterior displacement the fragment becomes

## FRACTURES OF THE CAPITELLUM AND TROCHLEA

wedged between the olecranon process of the ulna and the posterior recesses of the joint.

One case occurred in a female fourteen years of age. Operative removal of the fragment by opening into the joint cavity was undertaken in three of the cases with improved motion of the joint and the cessation of spontaneous pain. The etiology in all of the cases was a fall or a blow on the slightly flexed forearm.

Steinthal<sup>9</sup> reported a case similar to that of Hahn in a young man. The fragment, consisting of the articular portion with a thin layer of underlying bone, was removed at operation. Wright<sup>8</sup> describes a case occurring in a female twelve years of age with operative removal of the capitellum. This fracture was distal to the epiphysial line.

An operative removal of the fragment was done by Cotton<sup>7</sup> on a female forty years of age who had sustained a fracture of the capitellum by falling down six steps striking on the left elbow. Six months later there was two-thirds normal function of the joint.

Stimson<sup>6</sup> cites a case occurring with compound fracture involving the condyles; also a second case with a partial separation of the capitellum, in which suture was done with a fairly good result; and a third case in which the fragment had united with the front of the humerus and was removed at operation.

An interesting feature of the two cases reported by Lorenz is the method of production of the fracture. Both were in young men, twenty and twenty-two years old respectively. One was swinging a heavy hammer, the other hammering with a heavy bar of iron. The force of the blow was transmitted through the hand and forearm, the head of the radius driving off the capitellum. There was posterior displacement of the fragment in both cases, removed at operation. A different mechanism producing anterior displacement is illustrated by the cases reported by Darrach.<sup>10</sup> A male, age thirty-five years, slipped on the sidewalk and had fallen first on his palm, then on his elbow. There was considerable pain at once, which was referred to the front of the elbow and made worse by extension. He was operated on six days after the injury, an incision being made through the anterior capsule. The capitellar fragment was located lying in front of and above its normal site. It was removed, its broken surface wiped free of newly formed granulation tissue, washed with hot saline and replaced after the humeral surface had been freshened. The radial head seemed to hold the fragment in position, so no attempts were made at fixation. A second case<sup>11</sup> occurred in a female aged sixty years, who fell on the ice, striking directly on the elbow flexed at a right angle. The X-ray showed a semicircular fragment of bone lying in the anterior recesses of the joint in front of the humerus. There was a line of fracture to be seen above the capitellum. At operation under local anæsthesia the capitellum was found to be fractured but not displaced, the loose fragment being the trochlea.

The outstanding features of the clinical picture of the cases reported in the literature, together with those of the cases presented here, are: (1) Spontaneous pain in the region of the fracture, not dependent upon motion; (2) No change in the normal landmarks of the elbow; (3) Progressive limitation of movement of the elbow-joint to fifteen degrees; (4) The finding on palpation of a bony projection in the antecubital fossa; (5) Crepitus caused by a loose body in the joint.

The characteristic X-ray appearance in these cases is that of a shadow in front of the lower end of the humerus which has the contour of the

articular surface of the joint, which is either transversely or obliquely placed, and absence of the normal cortical articular marking in the region of the lower end of the humerus from which the fragment has been broken off. The absence of a defect in the antero-posterior view is explained by the fact that the articular surface which is broken off and displaced points to the front and that the posterior portion of the lower end of the shaft in the region of the fracture is left intact. The displaced fragment early begins to undergo changes, due to bone absorption and proliferation, followed by union with the bony surface upon which it lies. The proliferation of bone may give rise to an incorrect diagnosis of myositis ossificans. The articular cartilage undergoes little change in appearance.

The treatment is excision of the fragment. Darrach replaced the capitellar fragment in one of his cases. The radial head seemed to hold the fragment in position. But after ten weeks the fragment had rotated outward a little. If the fragment unites in malposition and is accompanied by excessive new bone formation, there is limitation of motion of the joint and constant pain from the resultant traumatic arthritis.

These fractures are distinct from the Posada<sup>12</sup> type of fracture, which is above the attachment of the ligament of the joint, and also from the fracture through the epiphysial line in children, which, as has been described by Ashhurst,<sup>13</sup> are extra-articular.

CASE I.—L. R., female, age sixty-one years, admitted to the service of Dr. D. B. Phemister, at the Central Free Dispensary, March 9, 1914, complaining of pain and swelling of the right elbow region, which followed an injury sustained two months previously. At that time she fell down two steps, striking on the outstretched hand. She was able to move the forearm on the elbow joint immediately after the injury, but since then, because of the pain and swelling, has held the joint immobile.

Examination shows a swelling of the elbow mostly in front. The forearm will flex on upper arm to only ninety degrees; will extend to about thirty-five degrees. Pronation and supination seem normal. There is only slight pain on making passive movement of the joint.

X-ray examination in the lateral view, Figure 1, shows a semicircular shadow lying in contact with the anterior surface of that of the humerus, beginning about one centimetre above the line of the elbow joint. The outline of the main portion of the shadow corresponds to that of the capitellum in its lateral view. This shadow is marked in its lower half by two small curved lines which correspond to the outline of the cortex of the grooves which lie to the mesial and lateral sides of the intercondylar ridge. In the line of the elbow joint the curved shadow produced by the trochlear surface is present, while that of capitellum and intercondylar ridge is absent. In the antero-posterior view, Figure 1, the shadow of the articular surface of the lower end of the humerus is present only in the region of the mesial three-fourths of the trochlea. Lateral to this point it is replaced by a faint, irregular line and the cartilage space cannot be made out. There is an indefinite shadow overlapping that of the humerus in the intercondylar region, which is produced by the displaced fragment. The patient refused operation and has not subsequently been seen.



FIG. 1.—A. Articular surface of capitellum. B. Articular surface of intercondylar groove. C. Irregular outline of fracture surface of the humerus. D. Articular surface of the trochlea.

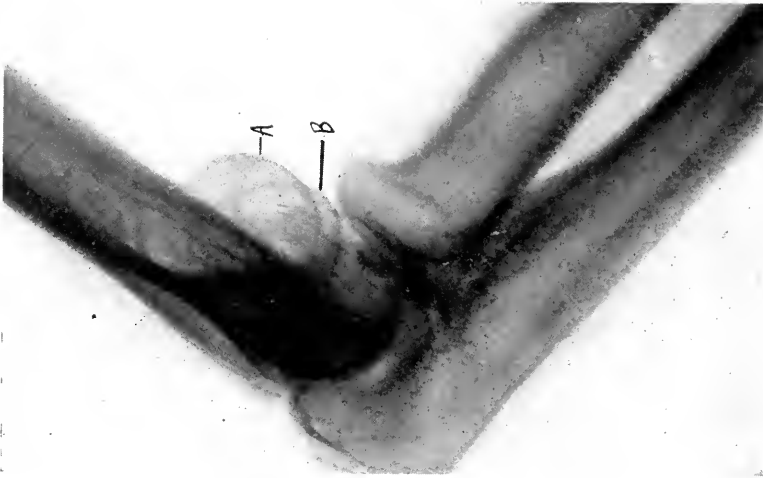


FIG. 2.—A. Articular surface of the capitellum. B. Articular surface of the intercondylar groove.



FIG. 3.—A. Lower margin of density caused by displaced fragment. B. Decreased density of external condyle.

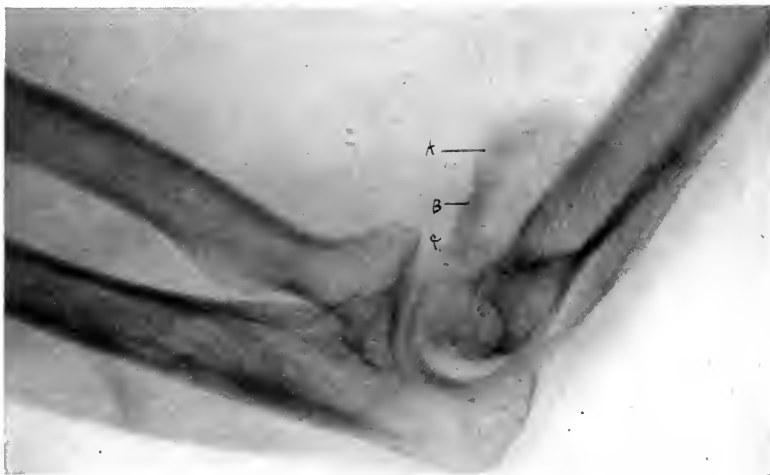


FIG. 4.—A. Capitellum. B. Intercondylar groove. C. Trochlea.

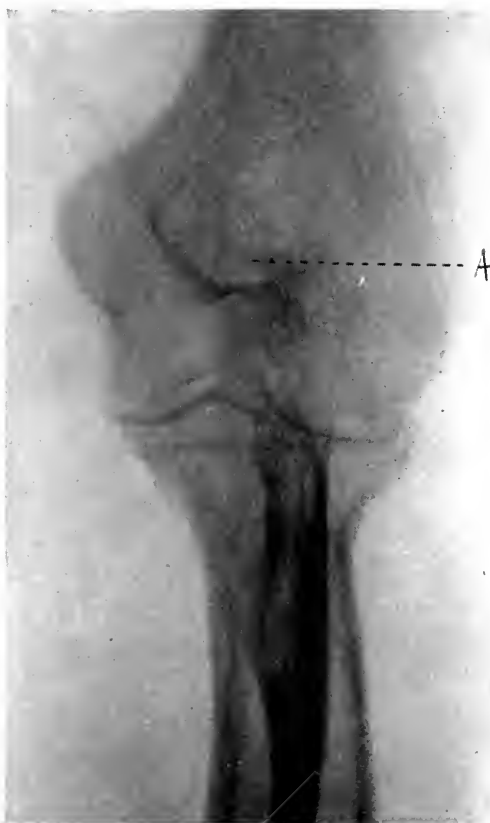


FIG. 5.—A. Density caused by fragment.





## FRACTURES OF THE CAPITELLUM AND TROCHLEA

**CASE II.**—C. A. T., male, age twenty years, admitted to the service of Dr. D. B. Phemister, at the Presbyterian Hospital, September 9, 1914, complaining of pain in and limitation of motion of the left elbow joint. Six months previously he fell upon his left hand with the arm completely extended. Following the injury he had severe pain in the elbow with loss of motion and marked ecchymoses of the skin of the arm. A diagnosis of dislocation was made at the time and an attempt at reduction was made under anæsthesia without appreciable change in the condition. The arm was bandaged and carried in a sling for four days. He did not use the arm for two months, then found that both extension and flexion were limited. Since then there has been no change.

Examination shows arc of movement, flexion and extension of left forearm limited to fifteen or twenty degrees, pain on forced movement. No crepitus or swelling is present. An oval bony swelling is felt on deep palpation over the anterior surface of lower end of humerus. Pronation and supination are normal.

X-ray examination. In the lateral view, Figure 2, there is a faint semi-circular shadow lying in contact with the anterior surface of the lower end of the humerus. Two semicircular markings of about the same diameter can be made out, one produced by the articular cortex of the capitellum and the other, lying one centimetre lower, by that of the trochlea. In the line of the elbow joint, instead of the normal curved outlines of trochlea and capitellum, a faint, blurred articular surface is seen. In the antero-posterior view, Figure 3, the width of the cartilaginous space of the elbow joint is approximately normal and the condylar ridges are filled out with bone, but the shadow cast by the external condyle is fainter than normal and the line of the articular surface of the lower end of the humerus is blurred and irregular over the capitellar and mesial trochlear regions. There is a faint transverse shadow in the intercondylar region, beginning three-fifths of an inch above the line of the joint. Its lower margin corresponds to the outline of the capitellum, intercondylar ridge and the greater portion of the trochlea. In this case there has been considerable regeneration in the region of the defect.

Operation, September 22nd. A longitudinal lateral incision was made, exposing the anterior portion of the joint capsule incision. A fragment of bone was found attached by fracture surface to anterior surface of humerus. It was removed and the wound closed.

When last heard from, five months later, there had been little improvement in the arm, motion being still limited and slightly painful.

**CASE III.**—S. L., female, age fifty years, admitted to the service of Dr. Dean Lewis, at the Presbyterian Hospital, September 27, 1921, complaining of pain in the left arm with limitation of movement at the elbow joint. About three months previously, while stepping onto the curb, she fell, striking on posterior surface of the left elbow. There was considerable swelling of the elbow with loss of function, ecchymoses into the skin and pain both when held quiet and when passive motion was attempted. The pain grew steadily worse until the joint was immobilized by application of a cast six weeks before admission. Arc of movement, flexion and extension of the left forearm at this time was about fifteen degrees; pronation and supination being normal. Considerable swelling still remains about the joint anteriorly, where it is also very tender.

X-ray examination: The lateral view, Figure 4, shows a faint bony shadow extending upward from the joint on the anterior surface of the humerus. Its anterior margin corresponds in outline from above downward with that of the capitellum, intercondylar ridge and lateral portion of trochlea. The shadow is continuous with that of the humerus, as if bony attachment had occurred. In

the line of the elbow joint the curved shadow produced by the remaining trochlear articular cortex can be seen, but that of the capitellum is absent. In the line of the elbow joint the curved shadow produced by the remaining trochlear articular cortex can be seen, but that of the capitellum is absent. In the antero-posterior view, Figure 5, the shadow of the articular cortex of the lower end of the humerus is likewise seen in the region of the mesial two-thirds of the trochlea, but is absent lateral to this point, where it is replaced by a faint, irregular line. There is a very faint indefinite shadow extending obliquely upward and outward from the trochlear region, overlapping the humerus shadow, representing the outline produced by the displaced bony fragment.

Operation, November 18, 1921: Longitudinal lateral incision of the left antecubital fossa. Capsule of joint opened. On the joint surface of the humerus above is a dome-shaped smooth elevation produced by the articular cartilage of the capitellum, with the trochlea extending downward to the line of the articulation. Bone which was adherent to humerus removed in pieces by rongeur forceps. Closure made of the wound. On November 26th there was a greatly increased arc of movement of the left forearm, almost twice that before operation. Pain was absent.

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## INJURY OF THE LIMBS DUE TO BACK-FIRE

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THE back-fire injuries are nowadays one of the commonest met with in the forearm (thirty-six per cent.). These injuries have been described for the last twenty years under the designation of "chauffeur's fracture" which became a synonymous term of the fractures of the lower radial third due to this cause. The aim of this paper is to prove that such a restricted meaning does not correspond to the clinical findings, and to complete some commentaries already given in another paper (ANNALS OF SURGERY, February, 1922).

I have examined several cases, records and skiagrams of 190 patients who have met with back-fire injury and the facts and conclusions arrived at can be summarized as follows: In 141 cases there was a definite type of bone lesion, and in the forty-nine remaining the injury had been limited—in the great majority of cases—to the soft structures of the lower forearm.

The bony lesions found were distributed as follows: Fracture of the radius alone, ninety-five cases; fracture of the ulna, one case; fracture of the radius and ulna, twenty-eight cases; fracture of the carpal bones, nine cases; fracture of the radius and scaphoid, one case; fracture of the ulna and scaphoid, one case; fracture of metacarpal, one case; fracture of humerus, one case; fracture of clavicle, one case; fracture of femur, one case; luxation of elbow, one case. Total, 141 cases.

Five of the above lesions were due to direct trauma and the remaining were all cases of the indirect type of injury.

The *radius* is the most commonly involved bone and it was fractured in 124 in a total of 141 cases (Figs. 1 and 2). The distribution of the line and types of fracture is rather irregular, showing, however, a remarkable prevalence for the lower third of the bone.

If the lower radial third is divided in three equidistant zones, it will be seen that it is in the lowermost portion that the fractures more commonly occur. In fact, sixty-nine fractures were seen at this level (Fig. I, Figs. 27 to 95, and 21 at the uppermost third of the lower radial third, Fig. I, Figs. 2 to 22). The middle third of the radius was free from injury. Although there were four cases of fracture to be seen at the middle third of the lower radial third (Fig. I, Figs. 23 to 26). In one single case there was a vertical short split of the inner brim of the radial head (Fig. I, Fig. 1).

The direction of the line of the crack at the lower end of the radius can be divided into transverse and oblique. The former are usually found at the upper third zone and in the epiphysal and supra-epiphysal fractures. The transverse split was seen in sixty-two cases (Fig. I, Figs. 2 to 63). In the thirty-one remaining the crack ran obliquely inwards and downwards in a complete line in the great majority of the cases (Fig. I, Figs. 64 to 95).

These oblique splits form the so-called variety of intra-articular fractures, and the fractured piece has a triangular appearance.

The lower internal angle of the triangle falls in the articular surface as follows: In twelve cases it was seen at the inner lower end of the radial articular zone (Fig. I, Figs. 64 to 75); in seven it ended in the interval between the centre and the inner end (Fig. I, Figs. 76 to 82); in seven at the centre of the articular surface (Fig. I, Figs. 83 to 90); in five at the outer side of the centre, forming a good type of styloid fracture (Fig. I, Figs. 91 to 95); and in one rare case the crack was of the double and combined type of oblique-central and inner-transverse epiphysial separation (Fig. I, Fig. 69).

This shows, therefore, that fractures of the styloid process are not so common as those extending to the inner side of the middle of the articular line. The longitudinal or medullary split was not seen in any case of the series.

With regards to the direction of the displacement of the fragments it can be said that they are usually seen to be inclined forwards in the upper third fracture of the lower radial third. Sometimes the distal portion is slightly projected inwards.

In the transverse fractures of the lowermost third of the lower radial portion it is noticeable that the proximal fragment is usually displaced forwards, and the lateral skiagram reveals, as a rule, a broader widening of the fracture space at the anterior side of the bone. This separation is ordinarily more obvious at the outer border of the bone, and occasionally it will be noticed some impaction of the fragments at the inner end of the bony diastasis. In fact, the gap is wider at the antero-external part of the radius, and this fact applies even to the triangular fractures of the lower radial epiphysis.

There were five cases of Colles' fracture in which the deviation backward of the lower fragment was well displayed. On the other hand, there were two cases of *reversed Colles or Goyrand fracture*.

The ages of the cases were distributed as follows: Between ten and twenty years, twenty-six cases; between twenty-one and thirty, forty-two cases; between thirty-one and forty, twenty-five cases; between forty-one and fifty, two cases. Unknown, two cases. This shows a predominance of back-fire fractures in fully developed bones. In fact, I have shown in other articles that age has apparently no bearing on the fracture being at the epiphysial line, which can be proved by looking at Fig. 1, where the age of the case is shown by the side of the fracture.

Ninety-five cases were of the right and two of the left forearm. Two were females and ninety-three males.

These cases were seen as follows: Within seven days of the accident, six cases; within thirty days, twelve cases; within six months, twelve cases; within one year, two cases; within eleven years, five cases.

These facts demonstrate the lower radial end to be the commonest seat of

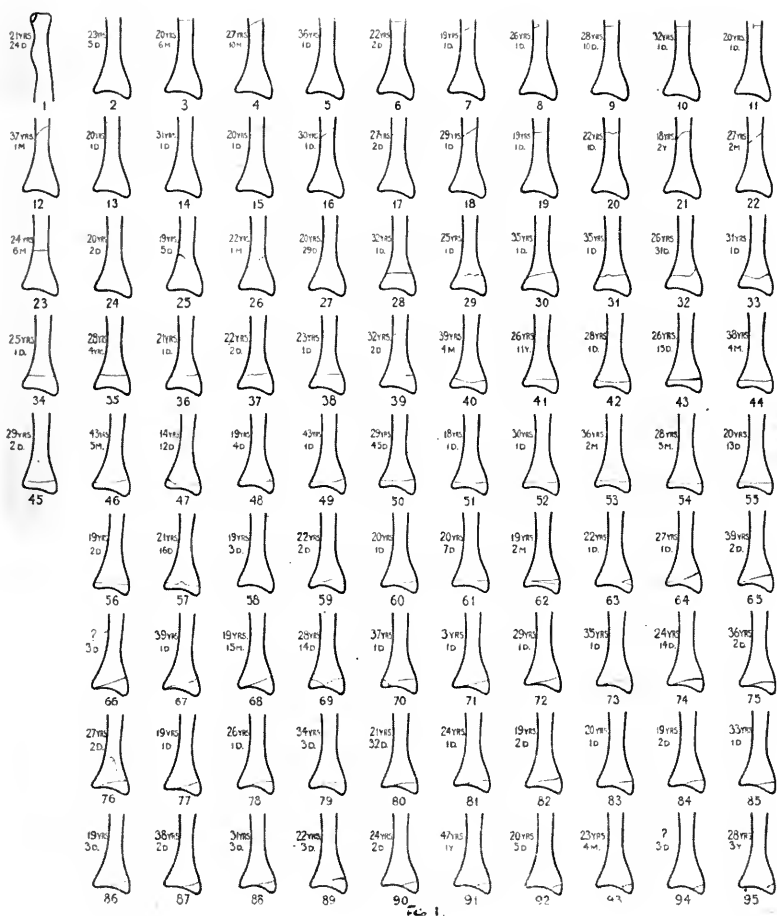


FIG. 1.—Shows ninety-five single back-fire fractures of the radius. Fig. 1 is a rare example of upper radial third fracture. (The ages of the cases and the dates when seen are given at the left-hand side of each figure.)

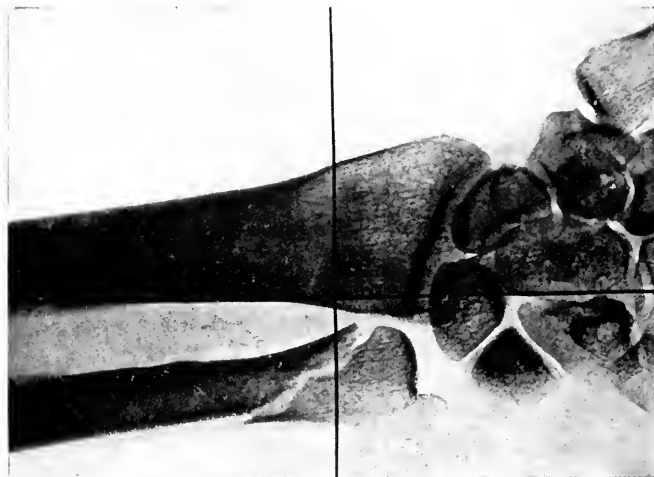


FIG. 4.—Shows a rare case of single ulna back-fire fracture.

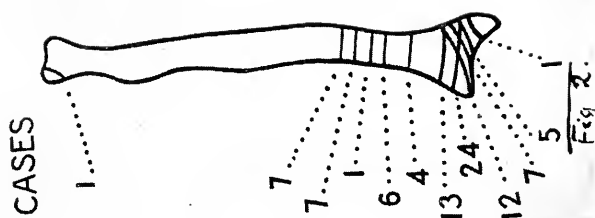


FIG. 2.—This diagram has been obtained by superimposition of all cases of Fig. 1. It is a synthetic diagram.

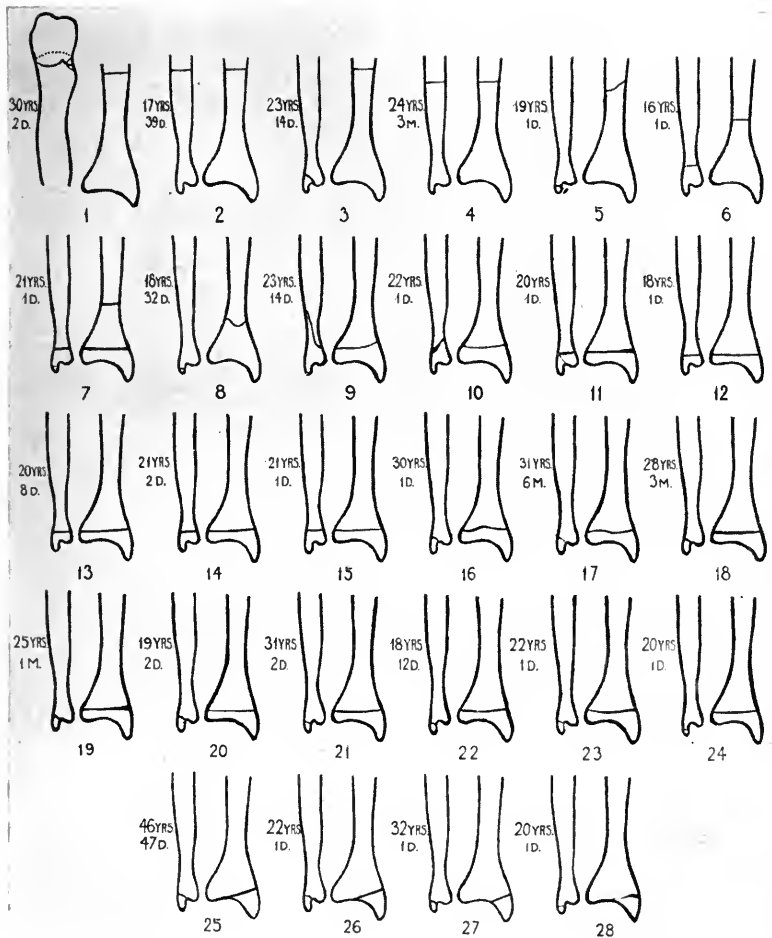


FIG. 5.—Shows twenty-eight cases of double forearm back-fire fracture.

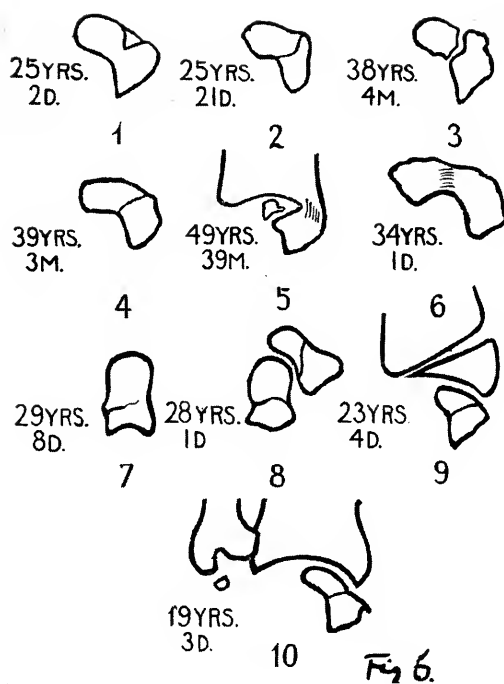


FIG. 6.—Shows ten cases of carpal back-fire fracture.



back-fire fracture (seventy-two per cent.). The epiphysial transverse crack is the commonest and the supra-epiphysial the next common.

Among these cases there was a case of recurrence of the fracture (Fig. I, Fig. 13), five months after the first accident.

In one case (Fig. I, Fig. 18), the cuneiform appeared pushed into the ulna, and the lower radial fragment was detached outwards and backwards.

In another case (Fig. I, Fig. 35), the radius was the seat of a very marked deformity. This fracture occurred four years previously, and the distal radial fragment was deviated as in the previous fracture. There was an apparently well-defined double supranumerary formation at the ulnar styloid neighborhood, which appears to be the "ulnare antebrachii" and the "triquetrum secundarium."

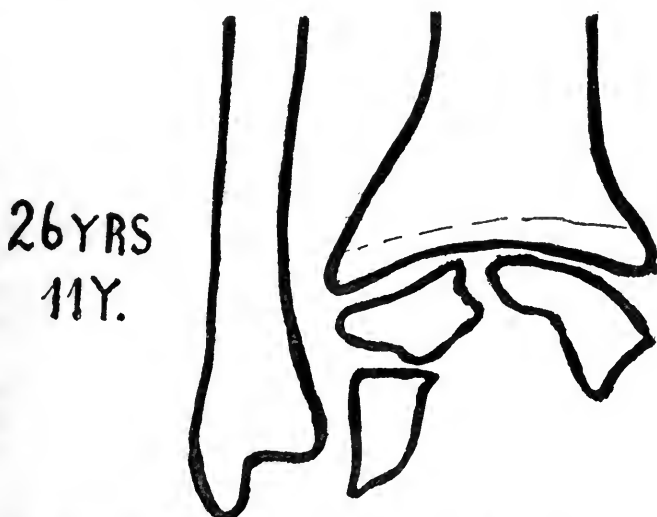


FIG. 3.—Shows a case of stopped growth of the lower radial epiphysis two years after back-fire fracture.

In Fig. I, Fig. 41, and Fig. 3, is exemplified a case of stopped growth. The accident occurred eleven years previously and the forearm appeared like a case of Madelung deformity.

In some cases the radiographic appearance of the bone lesions is only limited to a shadow at the epiphysial line (Fig. I, Fig. 42). This is rather frequent and forms a good radiographic appearance of the so-called *epiphysial strain*. There were twenty-four epiphyseal separations (Fig. I, Figs. 32 to 63), of which two were incomplete (Figs. 62 and 63). There were ten greenstick fractures (Fig. I, Figs. 78, 11, 14, 25, 33, 37, 62 and 95).

Two of the radial fractures were due to the direct action of the handle.

The *ulna* alone was fractured in two cases. These fractures occurred at the lower third of the bone as follows: In one the crack was complete and of the transverse type, at the upper third of the ulnar lower third. There was a marked anterior bowing of the fragments. In the other case (Fig. 4),

the crack ran obliquely upwards and inwards in the lower end of the bone in a spiral fashion. This fracture is a rare type of lesion. The ages of these individuals were twenty-one and twenty-five years. This shows the rarity of the single ulnar back-fire fractures.

The distribution of the *combined radial and ulnar* fractures was as follows: Radius, upper third of the lower third, six cases (Fig. V, Figs. 1 to 6); middle third of the lower third, one case (Fig. V, Fig. 7); and lower third of the lower third, twenty-one cases (Fig. V, Figs. 8 to 28). Ulna, coronoid, one case (Fig. V, Fig. 1); upper third of the lower third, two cases (Fig. V, Figs. 2 to 4); epiphysial, nine cases (Fig. V, Figs. 6, 7, 9 to 15); styloid, sixteen cases. Among the last there were four cases which apparently resembled the "*os triquetrum secundarium*" or the "*ulnare antebrachii*" (Fig. V, Figs. 7, 8, 24 and 28).

If the radius is analyzed by itself it will be seen that the commonest variety of split corresponds again to the epiphysial separation (seventeen cases); the transverse crack at the upper third zone of the lower radial third is the next common and occurs in six cases; and in the four remaining the fracture has a triangular shape and was located at the styloid portion of the bone. In fact, the radius behaves exactly as when fractured alone.

The ulna, on the other hand, reveals very interesting features in its back-fire traumatology. Thus, the styloid tip is the most vulnerable portion of the bone (eighteen cases). Among these cases four, however, appear to be normal separations or congenital non-fusions. The epiphysial line is the next in order of frequency (nine cases).

In one case (Fig. V, Fig. 25), there was a wedge cut off at the back of the distal ulnar fragment, and the same occurred in Fig. V, Fig. 26, at the corresponding portion of the radial triangular bit. These are special cases of marginal fracture.

The ulna was broken above the level of the radial fracture in one case only (Fig. V, Fig. 11). This was a very interesting fracture of the outer coronoid brim and already alluded to (*ANNALS OF SURGERY*, February, 1922).

The ages of these individuals and the time when seen are shown by the side of the diagrams.

There were eleven cases of *carpal injury*, as follows: Fracture of the scaphoid, four cases (Fig. VI, Figs. 1 to 4); fracture of the scaphoid with extrinsic radial synostosis, one case (Fig. VI, Fig. 5); compression fracture of the navicular-semilunar junction, one case (Fig. VI, Fig. 6); fracture of *os magnum*, one case (Fig. VI, Fig. 7); fracture of the scaphoid and *os magnum*, one case (Fig. VI, Fig. 8); retro-ulnar luxation, one case. These cases have been described elsewhere (*Surg., Gyn. and Obst.*).

In one case the proximal scaphoid portion was removed by an open operation, and in the case of the retro-ulnar dislocation, the displacement was reduced under general anæsthesia. This patient was thirty years of age and was seen a few moments after the accident.

The triangular fracture of the *radial styloid associated with compression fracture of the navicular neck* was seen in one case (Fig. VI. Fig. 9). The lateral skiagram reveals the radial gap to be wider at the front of the bone, and a backward dislocation of the lower scaphoid.

In one case the *scaphoid fracture was associated with a crack of the ulnar styloid* (Fig. VI, Fig. 10). This case was probably a supernumerary bone. Although it cannot be definitely stated as such, on account of the irregularity of the edges of the split, and some slight periosteal thickening around the proximal styloid segment. These facts point to the vulnerability of the scaphoid, which was broken in seven per cent. of the total cases of the series.

The back-fire fractures are essentially, as it was shown above, fractures of the wrist. The radius is more commonly involved, as it is the most fragile bony structure of this anatomical region. The surprising fact lies in the comparative frequent lesion of the ulna lower end, which is not the rule in the general traumatology of this bone. The scaphoid is the next important structure involved.

The flexion hypothesis (Ghillini), the traction theory (Lucas-Championnière, Destot, Sorel, Walther), . . . the abduction mechanism (Caccia), explain some of these fractures only. In fact, the physio-pathology of the back-fire fracture is complex, because it concerns a multitude of anatomical attitudes, physiological possibilities, and mechanical stages which render the problem of its systematization a difficult task.

The combined flexion-compression theory (Cotton, Pilcher, Stevens) appears to explain the well-known fact, revealed in some cases by the X-ray examination, of the wider opening of the fracture at the ventral surfaces of both radius and ulna, as it was shown above. The same fact was demonstrated in some cases at the outer border of both radius and ulna (Fig. I, Figs. 43, 74, 89; Fig. V, Figs. 10, 11, 28; Fig. X, Fig. 9). These appear to be types of injury in which a marked degree of wrist adduction or abduction was added to the trauma. The hyperextension of the wrist appears to be the dominant feature of these injuries. Although there is always another extra element which seems to be an auxiliary, as it were, in promoting the enormous variety of these fractures. May it be the degree of lateral position and strength of the pull at the wrist, which are therefore added to the hyperextension. It appears that by the abduction of the wrist, accompanied by more or less marked degree of extension, the naviculo-radial contact becomes more intimate and a fracture compression of the radius or navicular, with or without scaphoid luxation, may occur. If the abduction is even greater, the internal lateral ligament of the wrist may be forcibly dragged downwards, and a similar phenomenon, as seen in the ankle fracture-dislocations, may take place here. This appears to be the best explanation of the common fractures of the ulnar styloid.

I have tried elsewhere to discuss the physio-pathology of the carpal injuries. The os magnum fracture, as it is said, appears to be due to pressure

of the navicular foot. I could find no clinical evidence of Sebileau's suggestion. He maintained that in some cases the starting handle of the motor goes back and stops suddenly. This will produce a sprain over the os magnum and perhaps rupture of the interosseous ligament between this bone, the unciform and the trapezoid.

The radial diaphyseal fractures occur at the lower portion of the shaft "where the junction of the triangular with the quadrangular sections of the bone takes place. The hand is fully supinated" (Caccia). This suggestion, based on mechanical basis, appears to be not entirely satisfactory. In fact, the supination is not the commonest attitude of the forearm while starting the engine, whereas these fractures are undoubtedly the most frequent in practice.

The degree of forearm flexion at the elbow, the amount of pronation, and the extent of forearm extension and arm abduction appear to explain the fractures of the radial head and the ulnar coronoid. In fact, there may be pain at the elbow or even at the shoulder without noticeable bony lesion (Ghillini, Sir R. Jones' case). Fig. I, Fig. 91, is a good example of humero-scapular concussion, and the pain was even marked for some months after the radial fracture. This mere pain is a minor stage preceding the fracture, and, contrary to Ghillini, it may occur even in cases of lower radial fracture.

Nervous injury was not seen among these cases. The injury may be due to the elongation of the nerve.

*The third metacarpal bone* was fractured across at its base in one case.

*The humeral epitrochlea* was broken in another case. They were both direct injuries.

*The elbow was the seat of a dislocation* in one case which was reduced a few hours after the accident. The ulna was displaced backwards and the radius backward and slightly outward. The tip of the olecranon was fractured as well.

*The middle of the clavicle was fractured* in one case "starting a lorry, the shoulder cracked." The last two cases were of the indirect variety and show the remarkable types that these lesions display. They are both good instances of distant effects of the trauma.

*The inner condyle of the femur* was broken in the case of a man forty-six years of age. The fracture was very slight and looked like a scale being taken off the condylar surface. It was due to the direct hit of the handle.

The above lesions show the great variety of fractures due to the direct hit of the handle or to the indirect pressure caused by the sudden backstroke of the engine.

The elbow luxation and the clavicular fracture are peculiar. The former appears to occur while the handle passes the two lower quadrants of its circular rotation, whereas the latter seems to take place in the two upper quadrants.

There were forty-seven cases of lower forearm *contusion*, which gave

negative radiographic evidence. The ages of these individuals were as follows: Between ten and twenty years, twenty cases; between twenty-one and thirty, fourteen cases; between thirty-one and forty, ten cases; over forty, three cases. They were seen: Within the first week of the accident, thirty-five cases; within the first month, seven cases; within the first six months, three cases; after the first year, two cases. The swelling over the lower radial region was obvious in the great majority of these cases, and in some a slight ecchymotic tint could be demonstrated around the wrist. The pain, however, is not localized as in cases of real fracture. It appears to be diffuse and irradiating towards the elbow at the back of the forearm. Although in some cases the styloid line appeared to be the maximum point of tenderness elicited by means of gentle finger tapping. These cases are good instances of *epiphysial strain*. In fact, these lesions, as it is shown above, are commoner among young individuals. A careful radiographic search reveals nothing abnormal. The clinical picture illustrates a condition previous to widening of the epiphysial line, which in its earlier stages is revealed radiographically by a faint shadow at the epiphysial junction. The next more advanced lesion appears to be widening of the epiphysial space at its outer anterior end, which precedes the real epiphysial separation, as it has been demonstrated above.

In one case seen three years after the accident, the hand was slightly swollen and the movements of the wrist were painful at the extreme degrees of flexion.

In the remaining two cases of the series, the inner side of the knee was swollen and tender, and the skiagram revealed nothing abnormal. They were recent cases of direct trauma.

*The prognosis* of these lesions is as a rule satisfactory. The grasping power of the hand seems to be decreased in some individuals, and in others diffuse pains in the wrist may occur every now and then for years after the accident. Among the cases of the series, one showed marked articular pains at the shoulder ten months after a lower radial third back-fire fracture. In another rare case examined eleven years after separation of the lower radial epiphysis (Fig. 3), the radius appeared two inches shorter than its fellow, and the hand consequently was markedly adducted.

### CONCLUSIONS

(1) The lower third of the radius and ulna is the commonest seat of back-fire fracture, and the carpal bones the next common.

(2) The crack through the epiphysial line of the radius is the commonest type of single bone lesion.

(3) The ulna styloid tip and radial epiphysial line are the commonest types of double bone lesions.

(4) The scaphoid is the commonest carpal bone involved.

(5) In individuals under twenty years of age the diagnosis of ulna styloid

fracture is more difficult owing to the common occurrence of irregularities of ossification.

(6) In twenty-five per cent. of the cases of the series the injury of the wrist was limited to the soft parts.

(7) The upper end of both radius and ulna are occasionally the seat of fracture.

(8) The age of the individual has no bearing on the fracture being at the epiphyseal line.

(9) The great bulk of these injuries is of the indirect type.

(10) The prognosis is usually good.

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# TRANSPLANTATION OF THE ENTIRE FIBULA IN CASES OF LOSS OF TIBIA FROM OSTEOMYELITIS

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IN April, 1912, the author<sup>1</sup> reported the results of the transplantation of the entire fibula as a substitute for the loss of the tibia in the same leg following osteomyelitis. The values of such transplants are several: First, the dangers from infection following a small exposure are largely minimized, as compared with a tibial graft. Second, failure is practically impossible, owing to the fact that the blood supply of the fibula is not disturbed. Third, the bone rapidly hypertrophies to take up the added weight and leaves no defect from the absence of the fibula. Fourth, fracture of graft is impossible.

The entire transplantation is, of course, used only in those cases following osteomyelitis of the tibia where no regeneration has occurred and the disability therefore is complete.

In practically all cases of osteomyelitis of the tibia, the upper and lower epiphyses remain the limiting barriers and are undisturbed so that the growing portions are not usually totally destroyed.

*Technic of Transplantation.*—Following careful preparation of the leg, an incision three inches long is made between the head of the fibula and the head of the tibia (see Drawing No. 1A) (Fig. 11) being careful not to injure or divide the peroneal nerve as it passes over the fibula.

The remaining tibia is then cupped out to take the fibula graft.

A longitudinal slit is then made in the periosteal covering of the upper fibula and the outer half gently freed from the fibula. The fibula is then osteomized as high as thought practical and by means of heavy traction is pried into this tibial cup. It is usually best to deepen this cup a little, thereby gaining better and quicker union. (See Drawing No. 1B.) (Fig. 12).

By leaving the periosteum on the outer side of the fibula intact both to the remaining fibula head and to the outer transplanted shaft, we gain a periosteal bridge which will often develop a bony bridge, thus more efficiently uniting the fibula and tibia. (See Cases I, II and III.)

The use of wire is unwise as union is always delayed in the presence of a foreign material. The wound is closed in the usual manner and a plaster applied from the toe to well above the knee. This remains on for two months, after which, a similar operation is performed on the lower leg. (See Drawing No. 2A and 2B) (Figs. 13 and 14) and diagrammatic sketch. (Fig. 10).

Usually two months following the second operation, weight-bearing is permitted, and either plaster or a caliper brace is used for a period of six to eight months.

It is surprising how quickly bone hypertrophy follows in the fibula with this added responsibility.

Note that the hypertrophy in Case I reached nearly the proportion of a normal tibia.

*Observations.*—1. Union is solid and takes place in record time.

2. The fibula hypertrophies, as seen in Case I of seven years' standing, and in Cases II and III of four and a half years and nine years.

3. Growth of leg continues and does not seem to be retarded.

CASE I.—A. L. This was a case of a young girl who in January, 1915, had an osteomyelitis of the left tibia and the right femur. She was admitted to the hospital on June 10, 1912.

*Physical Examination.*—Negative except for the local examination, which showed many discharging sinuses over the left tibia and the right femur. Wassermann negative.

On June 25, 1915, the entire tibia was removed from the epiphysis to epiphysis and plaster cast applied from groin to toes. Femur curetted, troughed and packed.

On March 1, 1917, there was no regeneration of the tibia—all wounds healed.

February, 1918, upper end of fibula transplanted into upper epiphysis of tibia—wound healed with only slight discharge in three weeks.

November 4, 1920, lower end of fibula transplanted into lower tibial epiphysis.

Wound healed in three weeks. Plaster case applied following each transplant from toes to groin. (See X-rays, Figs. 1, 2, 3, and 4.)

Functional result excellent seven years after operation.

CASE II.—N. G. This is the case of a young boy who had an acute osteomyelitis of the tibia in April, 1917, which resulted in marked destruction of the greater part of the tibia. This osteomyelitis was treated up to November, 1917, when the wound was healed. On May 23, 1918, the fibula was transplanted into the epiphyses of the tibia as in the previous case.

March 17, 1919, X-rays show hypertrophy of the fibula. (See X-rays, Figs. 5 and 6.)

Functional result excellent four years following transplantation.

CASE III.—L. B. This young girl, at the age of thirteen, was seen by her physician for pain and discharge of the lower leg. Two years' duration. At the first onset the pain had been sudden, accompanied by temperature ranging from 101 degrees to 104 degrees. Three operations were performed, each consisting of the removal of a portion of the tibia.

April 15, 1909, this case was seen by one of the writers and the examination showed four discharging sinuses along the tibia. A diagnosis of chronic osteomyelitis was made and X-ray showed the whole tibia honeycombed and practically sequestered.

*Operation.*—May, 1909, the whole tibia excised, only the epiphysis remaining. The periosteum resutured.

November, 1909, as there was no evidence of an attempt to regenerate a new tibia, the upper end of fibula was transplanted into the upper epiphysis of the tibia; the wound healed in two weeks.

December 31, 1909, the lower end of the fibula was transplanted into the



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lower epiphysis of the tibia. The wound healed in two weeks. (See X-rays, Figs. 7 and 8.)

Functional result excellent twelve years following transplantation.

CASE IV.—C. W. M. Two years previous this man had a compound comminuted fracture of both bones in the right lower leg, with the loss of two and one-half to three inches of bone. He had four operations. Examination on August 22, 1921, showed a two and one-half inch gap at the junction of the middle and lower third of the tibia with a tendency to varus. The wound has since February, 1921, been healed.

*Diagnosis.*—Non-union of old fracture of the tibia.

August 26, 1921, lower end of the fibula transplanted into the lower end of the tibia. Wound healed in two weeks. (See X-ray, Fig. 9.)

September 20, 1921, upper end of fibula transplanted into the upper end of the tibia. (See X-ray, Fig. 9.)

December 28, 1921, lower fragment solid, upper fragment has slipped. To have another operation in two months.

February 14, 1922, upper end of fibula placed in approximation with tibia and then sutured with kangaroo tendon. Convalescence thus far uneventful. (See X-ray, Fig. 9.)

Clinically, one can see no reason why a perfect functional result should not follow.

## LITERATURE

Campbell, W. C.<sup>1</sup>: Transference of the fibula as an adjunct to free bone graft in tibial deficiency. *J. Orth. Surg.*, October, 1919, vol. i, pp. 625-631.

Three cases are reported by the author. In order to make the success more certain in this condition, Campbell uses the following technic: An incision in the skin about four inches in length is made over the lateral aspect of the head of the fibula, the deep fascia is incised, then the capsule of the tibio-fibular joint. All cartilage and fibrous tissue is removed from the head of the fibula, being careful not to injure external popliteal or peroneal nerves. Next a cavity is made in the inferior and external aspect for the reception of the denuded head of the fibula. Heavy traction will place the head of the fibula within the cavity, provided scar tissue between tibial fragments does not prevent. When such difficulties arise these tough bands are excised or severed, the periosteum of the fibula is sewed to the periosteum of the tibia and the wound closed with catgut throughout. The final step is to do the inlay graft in the usual manner, which needs no description. This method has been successfully employed in the three cases. The advantages of the procedure are: 1st: It is possible to lengthen the limb one and one-quarter inches. 2nd: Early transference of head will stabilize limb and prevent shortening; 3rd: At the end of eight weeks we have a stabile limb in which no false motion is possible between knee and ankle. 4th: Early stability prevents motion and facilitates the development of the free graft. 5th: New blood supply is added to the tibia through the medium of the fibula, promoting nutrition. 6th: Greater chances of complete success. One point that Campbell especially desires to emphasize is that a two-stage operation should be done in all cases where there is much difficulty in making the limb straight from contraction of dense scar tissue. Most patients will readily submit to the second operation when such marked improvement follows the first.

C. J. Bond<sup>2</sup>: Transplantation of the fibula; osteomyelitis. *Brit. J. Surg.*, vol. i, p. 610, April, 1914.

CASE I.—Little girl, aged four years. Shaft of right tibia had been destroyed by osteomyelitis in June, 1904. The right fibula was cut across just below the head of the bone and this portion, with the epiphysal cartilage, was left in normal

position. The divided end of the shaft of the fibula was then pushed over to the inner side and inserted into the freshened lower surface of the tibial epiphysis, to which it was wired in position.

Within the next two months firm, bony union had taken place. Bony out-growth took place from the isolated upper fragment of the fibula. The upper end of the shaft of the fibula began to assume the outline characteristic of the normal tibia. In March, 1907, fibula was divided just above external malleolus and lower end of shaft was displaced inward and inserted into soft cancellous tissues of the lower tibial extremity. The child now walks and runs with the aid of a high-soled boot without any noticeable limp.

CASE II.—A boy, in whom the shaft of the right tibia was destroyed by osteomyelitis in 1907. This was removed as a sequestrum in November of that year when the boy was ten years old. The place of the lost tibia was supplied by transplanting the shaft of the fibula in two stages, as in Case I. At the first operation, in March, 1908, the shaft of the bone was divided just below the head. It was then displaced inwards and the cut surface wired to the freshened tibial extremity somewhat to its outer edge. In May, 1908, the lower end of the shaft was divided above the external malleolus and embedded in the cancellous tissue of the lower tibial epiphysis.

Owing to the contraction of the soft tissues of the limb, due to the absence of the tibial framework, considerable pressure was exerted on the lower end of the shaft and this gradually forced the end of the bone deeper into the spongy tissue until it eventually passed right through the epiphysis, almost passing through into the joint. Unfortunately, in this case, the disease affected the left tibia, destroying about two inches of the bone and producing a bad anterior posterior deformity of the limb at this spot; about one and one-half inches of soft bone were removed and ends of divided shaft wired together. This necessitated a subperiosteal division of the fibula at the corresponding level. A year after the operation shows a restored shaft with a single central medullary canal and no callus. It is impossible from an examination of the limb on the skiagram to say that the fracture had occurred at this spot.

H. Schloffer\*: *Zur Osteoplastik bei Defekten der Tibia*. Bruns. Beitr. zur klin. Chir., vol. xxv, 1899, p. 76.

The transplantation of a graft from the fibula to the tibia was first practiced by Hahn.

Lilienthal writes of a wonderfully successful operation of this nature in a boy of nine years with absence of bony matter from the tibia due to fracture. The surgeon severed the fibula and fitted the upper end of the shaft into the tibial fragment. Within four months consolidation took place. McBurney simply sutured the head of the fibula to the tibia with favorable results.

Gangolphe\*: *Considerations sur la resection du tibia pour osteosarcomes et sur l'utilisation du perone*. Lyon Med., 1909, vol. cxiii, pp. 749-751.

Patient suffering from suppurating tibia following fracture and which the author suspected of being an epithelioma. The author decided to make a large diaphyseal resection of the tibia, causing the patient to support his weight on the fibula. If the weight of the body does not exceed sixty kilograms this is possible. The author advises the use of the fibula of the other leg as, in case of some mishap in the operation, the patient stands more chance of recovery. The patient mentioned was operated on successfully by this method by another surgeon.

M. Brandes\*: *Die Heilung grösster Tibiadefekte durch Transplantation*. Med. klin. Berl., 1913, vol. ix, p. 1493.

The author advises the use of the fibula of the same leg for transplantation because it is the material nearest at hand and, being usually strong and hypertrophic, is splendid material for bridging the tibial deficiency. The head of the fibula

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is split and the upper end of the fibular shaft implanted in the upper fragment of the tibia and then the lower end of the fibula is implanted in the lower fragment of the tibia. The result is a fusion of the tibia and fibula into a new bone formation which permits the movement of the leg. Two children, having undergone this operation, walk easily.

Berard<sup>1</sup>: Greffe d'une portion du perone gauche dans une perte de substance de ten cm. du tibia droite, consecutive a une fracture pathologique avec dystrophie osseuse. *Lyon Chir.*, 1913, vol. ix, pp. 574-8.

The patient, twenty-seven years old, had three successive fractures in the same place in seven years. The first two fractures consolidated normally. The third left the leg impotent, shortened by about three cm., curved slightly inward, and with pains. The author uncovered the tibial focus, which presented a swelling which had the appearance and consistency of an egg shell.

In the interior of this cavity was a little serosanguineous liquid and some pimples forming an interrupted membrane. After ablation of the entire diseased bony area, the author realized a loss of bony tissue amounting to nine or ten cm. at the two poles of which the medullary canal was closed by a bony shell. The author then resorted to ablation of the left fibula, without its periosteum, to a length of twelve cm. The fragment of the fibula was inserted into the medullary canal of the tibial fragments. The operative results were uncomplicated. After five months the right leg was consolidated. The patient walked easily with a metal support.

Lapeyre<sup>2</sup>: Autogreffe de la diaphyse peroneale pour remplacer la diaphyse tibiale necrose et sequestree osteomyelite. Réstauration du tibia autour de la greffe. Guérison avec résultat fonctionnel excellent. *Bull. et Mem. de Soc. de Chir. de Paris*, 1914, n.s. vol. xl, pp. 182-90.

A child of three years came for treatment July 16, 1912, for an acute affection of the lower leg which had begun November 27, 1911. Upon the author's first examination the tibia seemed in a necrotic state, which seemed to involve nearly the whole diaphyses. The upper and lower epiphyses were curetted and cleaned. Fifteen centimetres separated the two osseous extremities. Suppuration persisted. It was vain to hope for a spontaneous reparation. On February 2, 1913, the author performed the fibular transplantation.

1. Careful curettage of the area to which the fibula was to be transplanted and extirpation of fungosities.

2. The section of the fibula at its lower extremity. The length of the graft was about thirteen cm.

The author did not dare to insert the two extremities of the fibula into the same epiphysis on account of the inflamed condition of the latter and decided to use two ivory pegs. For two or three months suppuration persisted at the upper end. At the end of three months consolidation was in progress. On September 10th the leg appeared solid. It had taken seven months to obtain this result. From a radiograph taken on this date the transplanted fibula showed itself to be completely surrounded by new bony tissue, irregular but solid. Suppuration had ceased. On December 10th, when the child left the hospital, he could walk with one cane. Thus transplantation of the fibula had saved a leg from amputation and reconstructed a useless member into a solid construction with splendid functional result.

Michon<sup>3</sup>: Perte de substance du tibia, consecutive a une blessure par eclat d'obus; transplantation du perone; guérison avec bon resultat fonctionnel. *Bull. et Mémoires de la Société de Chirurgie de Paris*, vol. 422, 1916, pp. 1719-22.

M. M. Sub-lieutenant, wounded by shell explosion on June 23, 1915, which resulted in a serious wound in the right leg. (1) A foot wound with tarsal fracture. (2) A fracture of the inner malleolus with a hole in the tibio-tarsal articulation. (3) A comminuted fracture of the medium tibia with important loss

of bony substance covering about three cm. The limb was immobilized. The inferior wounds cicatrized after prolonged suppuration. The malleolar fracture was consolidated with tibio-tarsal ankylosis and a slight degree of equinism. On January 22, 1916, seven months after the accident, the author performed a transplantation of the fibula of the same leg, following the technic of Barbet.

The operation consisted of the liberation and resection of the two tibial extremities by an internal incision and a section of the fibula by external incision. The fragment of the fibula, obtained by double section and adhering always to the interosseous membrane serving as pedicle, was thrust between these and the muscles of the anterior leg; the two extremities, bevelled, were both introduced into the medullary canal of the corresponding tibial fragment. The operation was long and tedious. The operative results were accompanied by suppuration and fever. The final results were satisfactory.

The leg is solid. The grafting is surrounded by new bony matter according to radiographs. The lower fragment of the fibula was welded to the tibia. The upper fragment was loose but caused no discomfort. The patient could walk with a cane.

P. Maucclair<sup>10</sup>: Grosse perte de substance du tibia; greffon emprunte au perone du cote oppose. Bull. et Mem. de Soc. Chir. de Paris, 1916, n.s. 12, 1864-66.

Case of a soldier who was wounded by a bullet, leaving a large wound in the tibia. This produced an arterial aneurism, osteitis of the calcaneum and violent retraction of the Achillis tendon. The wound suppurated for a long period. Three months after cicatrization the author transplanted a graft from the fibula of the other leg. Above he sunk the graft into the medullary canal. Below he fastened it to the tibial groove with catgut. The author does not feel ready to advise the maximum length of bone to be taken for grafting. In the present case he used seven cm. of the fibula. In this patient the consolidation was rapid and the patient walks easily. The leg from which the graft was taken is in good condition. The tibia suffices by itself for the functions of the leg, if judged from the six cases of fibular grafts made by the author.

For good consolidation it is necessary to sink the graft in the medullary canal as soon as possible. After the grafting the author sectioned the Achilles tendon to correct the equinism, then he scraped the necrotic calcaneum. The author states his intention of getting X-ray picture of this operation after one year has elapsed.

Pierre Barbet<sup>11</sup>: Revue general de la reconstitution du tibia detruit par transposition du perone voisin. La Clin. Par., vol. vii, 1912, pp. 65-69.

It is evident that the Hahn-Huntington operation is beneficial. It furnishes almost certain results (showing only two partial failures in twenty-seven cases). From the functional standpoint it seems superior to other grafts. The cases show almost identical post-operative history: rapid consolidation, return of muscular vitality, progressive hypertrophy of the transplanted fibula.

This operation is then preferred before all others. (1) In cases of destruction of the bony tissue due to osseous necrosis with death or insufficiency of regenerating periosteum. (2) After periosteal resection of an osteosarcoma of the tibial diaphysis. (3) After resection of the foci of old pseudo-arthritis, followed by fracture with atrophy of the fragments.

Bond, C. J.<sup>12</sup>: On the late results of three cases of transplantation of the fibula, with remarks on the process of growth and the physiological development of transplanted bone. Brit. J. Surg., April, 1914, vol. i, pp. 610-624.

Bond gives credit to Huntington as being the first surgeon to publish a case in which a successful attempt had been made to replace the whole shaft of the tibia by transplanting the shaft of the fibula into its place. The surgical results of the author's first two cases are as follows: The end results of bone transplantation in both cases (in one of which amputation had been suggested) Bond thinks



FIG. 1.—Case I. A. B., taken April 12, 1916, before operation for transplantation of the fibula (A-P view).



FIG. 2.—Case I, A. L., lateral view taken April 12, 1916, before transplantation of fibula.



FIG. 3.—Case IV, Moulton. Radiogram taken five months following lower transplantation and one week following upper transplantation.



FIG. 4.—Case I, A. L., post-operative radiogram, January, 1922.





FIG. 5.—Case II, N. Y.



FIG. 6.—Case II, N.Y. Post-operative radiogram, taken January, 1922.



FIG. 7.—Case III. L. B. Radiogram taken twelve years after operation.



FIG. 8.—Case III, L. B. Radiogram taken twelve years after operation.



FIG. 9.—Case IV, C. W. M. Showing transplant of fibula into tibia.

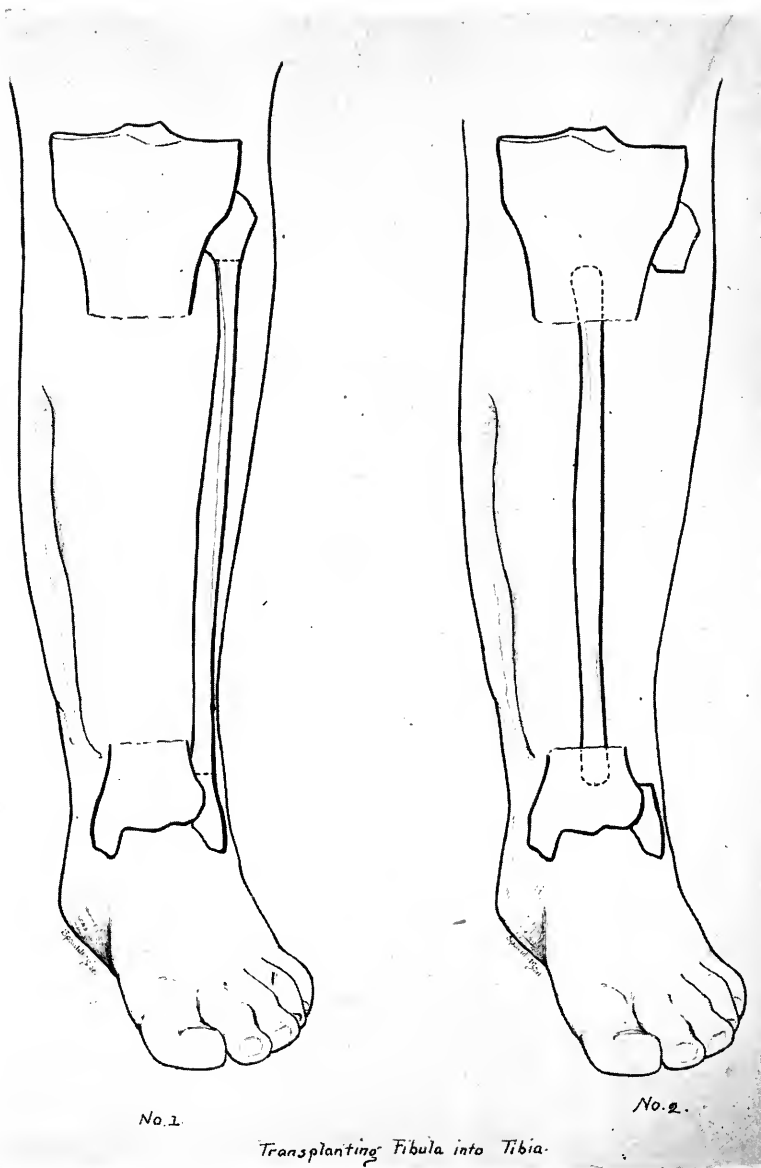


FIG. 10.—Diagrammatic sketch showing result of transplant.



FIG. 11.—Drawing 1A, showing point of division of fibula preparatory to transplantation.



FIG. 12.—Drawing 1B. Transplantation in place.

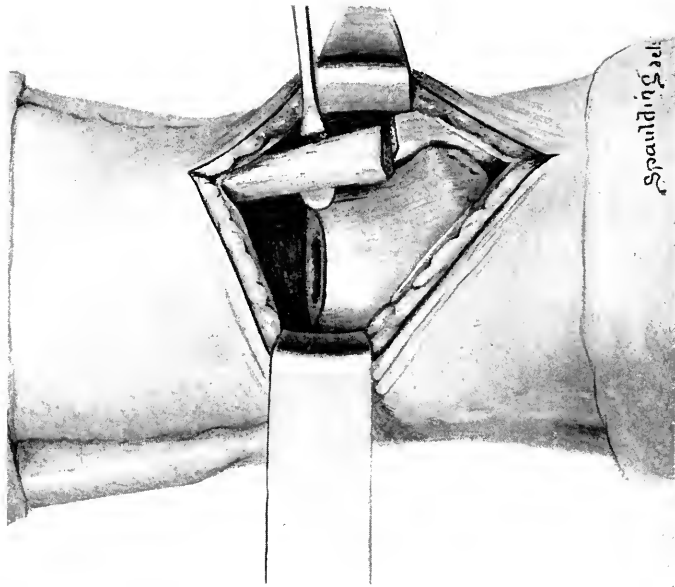


FIG. 13.—Drawing 2A, showing point of division of lower fibula preparatory to transplantation.

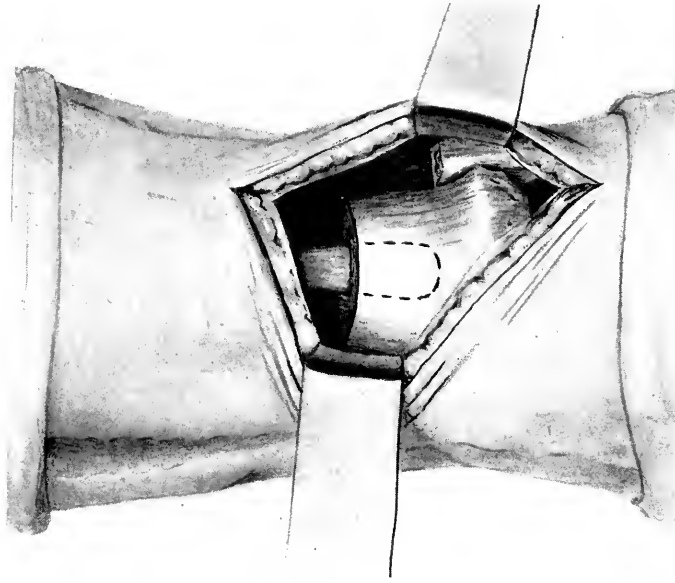


FIG. 14.—Drawing 2B, showing transplantation of lower fibula in place.



can be called satisfactory). The functional result is good. Both children can walk and run well without assistance, one without any noticeable limp and the other with only a slight one. From the surgical point of view the problem is how to secure the continuous growth in length of transplanted shaft and how thus to prevent the shortening of the limb, which occurred in both these, as in other recorded cases. In regard to this question of stunted growth, no doubt, much will depend on the extent to which the disease which destroys the original shaft also damages the osteogenetic capacity of the epiphysal cartilages, especially the one which exercises the greatest influence on the growth of the leg bones.

It was with the double object of restoring this capacity of bone formation to the damaged epiphysal cartilage and of counteracting the deformity of the limb caused by the unopposed growth of the fibula that Bond performed another operation on his third case. This case was a child aged four, who in 1903 developed a tuberculous focus in the upper epiphysis of the left tibia which partly destroyed the epiphysal growing line. After abscess formation and recovery a considerable deformity was left and the limb was carried inwards at a sharp angle below the knee by the unopposed growth of the fibula on its outer side. In November, 1905, the left fibula was divided just below the head of the bone and this with the epiphysis was removed. A V-shaped portion of bone was then removed from the inner side of the head of the deformed tibia in the situation of the normal epiphysal junction. The deformity was then corrected by forcibly straightening the shaft of the bone. The removed head of the fibula was now cut down to a V-shape and was inserted into the wedge-shaped gap in the head of the tibia so formed and the wound was closed. The grafted cartilage healed well in its new position. The child now walks fairly well. There is, however, still some shortening of the limb and some internal rotation of the foot, showing that the growth of the tibia has not kept pace with that in the opposite limb. The author's first two cases showed no increased growth; it made no attempt to take on new developments as long as it was connected with its own epiphyses, even though the tibia had been destroyed and it was exposed to new strains, but as soon as the shaft of this fibula became attached to tibial epiphyses, it began at once to assume a new outline and grow like the tibia. This fact suggests that it was the influence of osteoblasts from the tibial epiphyses which brought about the change and started the growth of the transplanted bone along tibial lines; it being a fact that in Bond's, as well as in other cases, the transplanted fibular shaft did develop into a bone of the size and shape of the tibia, shows that the failure to do so in some cases is not due primarily to the fact that the transplanted bone is "naturally" a smaller bone, but to the fact that it is not sufficiently taken over, or its growth is not sufficiently stimulated, by osteoblasts of tibial origin.

Torrance, Gaston<sup>22</sup>: Excision of the whole shaft of the tibia; replaced by transplanting the fibula. Surg., Gyn. and Obst., Feb., 1912, vol. xiv, pp. 184-186.

This case was a boy, six years of age, admitted to hospital May 15, 1908, with the history of having struck his right leg with a hammer over the middle of the tibia. An abscess formed at the point of injury, which was incised and curetted and healed up but reopened, and was operated again a few weeks later. Congenital syphilis was suspected, but no history could be elicited to confirm this. A considerable portion of the shaft had been chiseled out at different times, leaving a persistent sinus. When patient came under Torrance's care, about three months after admission, he was very much emaciated and ran a constant temperature. A skiagraph showed the tibia much enlarged and in an unhealthy condition.

Excision of the tibia was proposed. Under ether an incision was made along the anterior border of the tibia and the bone was sawed in two with a Gigli saw, leaving about an inch of bone at either end; the shaft was removed without any attempt being made to preserve the periosteum; the fibula was then sawed in two

at the upper end and transplanted to the stump of the tibia and was held in place by suturing the muscles up snugly around it. The leg was placed in a wire splint. A skiagraph, made a week later, showed the fibula to be in good position. His general condition began to improve at once. He was allowed to be up on crutches at the end of four weeks and was in good physical condition. Two months after operation two large ulcers developed near the point of the original injury and grew larger and deeper under local treatment.

He was put on potassium iodide and the dose rapidly increased to forty drops of the saturated solution, three times daily. He bore this treatment well and the ulcers healed rapidly. On questioning the father again he admitted that the child had contracted syphilis from kissing a relative at two years of age and had been treated for about a year. A skiagraph, made five months after operation, showed that the fibula had about doubled in size and that the union with the tibia was rounded off, resembling a joint "wiped" by a plumber. A few weeks later he was walking on the limb without a splint or crutch; the only difficulty he experienced was a slight tilting of the ankle. The lower end of the fibula was transplanted ten months after the first operation. He was allowed to walk about on crutches for two months and then lateral splints were applied and he was allowed to put some weight on the leg.

He was again seen in August, 1911, when a photograph and the last skiagraph was made. The muscles of the leg are well developed and there is no shortening; while the skiagraph shows some bowing of the shaft, the general lines of the leg are almost perfect and when standing with long stockings on it is not possible to tell which is the operated leg. He runs, jumps and plays with the other children and has perfect use of the leg.

T. W. Huntington<sup>14</sup>: Case of bone transference. Use of a segment of fibula to supply a defect in the tibia. *ANNALS OF SURGERY*, February, 1905, vol. xli, pp. 249-251.

Huntington's case illustrates the possibility of supplying a tibial defect amounting to absence of nearly the entire diaphysis by the appropriation of corresponding portion of the fibula. The early history of the case is that of an acute, infectious osteomyelitis of the left tibia. The patient, a boy of seven, entered the hospital in May, 1902. The trouble began a few days before. While at play he sustained a slight injury to the left leg just below the knee. Leg became swollen, tense and acutely tender. There was high temperature succeeding a chill. The attending physician made a small incision about three inches below the knee, from which, at time of admission, there flowed a small amount of clear yellow fluid. Tibia was extensively denuded and near the ankle there were two red fluctuating areas. An incision along the spine of the tibia from the tubercle to one inch above the ankle-joint revealed the fact that nearly the entire shaft was disintegrated. Pus oozed through several sinuses leading to the medullary cavity. On stripping the periosteum, the cortical portion of bone was readily scooped out with a curette, leaving a trough of periosteum. Having in mind the possibility of bone reproduction, the periosteum was stitched into a tube of small calibre. The wound was drained, partly closed and the leg laid upon a posterior splint. For three months there was gradual and satisfactory progress and the wound was fully healed. Six months later, despite an apparent effort on the part of nature to reproduce the tibia, there was still an interval of about five inches between the upper and lower fragments and progress here seemed to be practically suspended. The leg could not be extended upon the thigh, but hung loose, flail-like, and utterly useless. On January 27, 1903, Huntington finally determined to supply the defect by sawing the fibula at a point opposite the lower end of the upper tibial fragment and attaching it thereto. This was done without

## TRANSPLANTATION OF THE ENTIRE FIBULA

difficulty and the divided end of the fibula was firmly planted in a cup-shaped depression in the tibia.

At this time the diameter of the fibula was about that of an ordinary lead-pencil. Union was tolerably slow but solidification was finally noted six months later. In September, 1903, the lad walked with the limb encased in two lateral splints as a support to the ankle-joint, there being a tendency for the foot to evert when the patient stands upon the affected member. Not satisfied, Huntington concluded to transfer the lower end of the fibula to the lower fragment of the tibia, which was done October 6, 1903. The wound healed kindly and on February 15, 1904, perfect bony union was secured. Since that time the patient has progressed admirably. The limb, though three-quarters of an inch short, has assumed the dimensions and in a general way the contour of the normal member. The transferred portion of the fibula shows that its diameter is now three-quarters of an inch, or practically the same as the opposite tibia. The lad joins in the ordinary sports of other boys and, despite the lateral deformity and slight shortening, he walks without support and with only the suggestion of a limp. In a similar case Huntington would insist upon the affected member being kept at rest until the second transposition could be effected; thereby avoiding the deformity, which is the only serious defect in this case. Considering the extensive destruction of the tibia which occurred before patient was seen by the author, he can conceive of no other method which would have offered a result so satisfactory as the one adopted.

J. S. Stone<sup>12</sup>: Partial loss of the tibia replaced by transfer of the fibula, with maintenance of malleoli of the ankle. *ANNALS OF SURGERY*, October, 1907, vol. xlvii, pp. 628-632.

The author's case was a boy five years old, who in June, 1904, had an acute dissecting periostitis beginning at the lower end of the right tibia and in six days stripping the bone nearly as far as the patellar tubercle. Owing to sloughing of the periosteum after removal of the shaft the tibia regenerated very imperfectly. Nine months after the onset of the trouble the bone had reformed for about one and one-quarter inches from the upper end. There was then a gap of about an inch. The fibula was normal. Thirteen months after the onset of the trouble he was admitted for operation. Since ten weeks after the trouble began he had been going about with a plaster bandage and Thomas knee-splint. The attachment of the upper end of the fibula had become loose so that the head of the bone could be shoved upward slightly and the foot moved inward for about two and one-half inches. There was marked shortening of the leg and the foot was a little smaller than on the sound side. The fibula had become somewhat hypertrophied, particularly at the middle of the shaft. All wounds were healed.

It was decided to transfer the fibula into the gap in the tibia. The upper end was transferred first. A vertical incision about three inches long was made directly over the lower end of the upper sound portion of the tibia. The cut was made directly through the periosteum which was separated on the fibular side for a vertical distance of about two inches. In order to reach the fibula more readily a second incision of one and one-half inches long was made directly down onto the bone on the outside of the leg. At about two inches from the upper end the fibula was then cut across with a chain saw. The upper end of the lower fragment was then inserted into a mortise cut in the tibia. The periosteum was reflected from that side of the fibula which rested in the mortise. The reflected periosteum of tibia and fibula were then sutured together with chromic catgut to maintain close apposition and the reflected periosteum of the tibia was further sutured as a cuff around the upper end of the fibula to hold it more securely in position. The incisions were closed with drainage. A sterile dressing and plaster bandage were applied. The boy was readmitted to the hospital five months after-

wards. The union between the upper end of the tibia and the fibula had become absolutely solid and the shaft of the fibula had materially increased in thickness. Five and a half months after the first operation a longitudinal incision was made anteriorly over the outer part of the lower end of the tibia. The bone was exposed. By careful dissection the lower end of the fibula was then exposed through the same incision and split horizontally with a chisel for a distance nearly four inches. A small pocket was cut in the cartilage covering the end of the tibial epiphysis just large enough to receive the inner half of the fibula.

The inner half of the fibula was then sprung into its new position in the tibia. Closure was made without drainage. A plaster bandage from the toes to the thigh completed the dressing. Three months later plaster was removed. A small granulating spot was found at the lower end of incision. Bony union was solid. Five days later a small piece of necrotic bone about three-quarters inch long was discharged. After this the skin healed solidly. A month later the boy began to walk on his leg, and ever since has used it without restraint. The problem presented in this case was the restoration to usefulness of a leg in which the fibula was sound, the upper end of the fibula was sound and in which the lower epiphysis of the tibia remained, but without any shaft for a distance of nearly five inches. The continued increase in the size of the transferred bone is most striking and corresponded in amount with the freedom of use which was allowed. In any similar case more prompt transfer of the bone would seem advisable. The length of time allowed between the steps of the operation might also have been shortened.

A. Keith<sup>10</sup>: Fibula transplantation to replace the necrosed shaft of the tibia. *Menders of the Maimed*. London, 1919, p. 273.

Keith states that the most instructive examples of bone transplantation are those in which the fibula has been used to replace the necrosed shaft of the tibia. The case he wishes to call attention to is that of Bond (*Brit. J. Surg.*, 1914, vol. i, p. 610), who operated in May, 1905. He also cites Professor Huntington as having carried out the first successful substitution of fibula for tibia, publishing an account of it in 1905 (*ANNALS OF SURGERY*, 1905, vol. xli, p. 249). The same problem had presented itself to two men situated on opposite sides of the earth and both had adopted the same method of solving it.

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## FIBROUS TUMORS OF THE FOOT

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A GLANCE at text-books and through the literature will show that tumors of the foot are very infrequently met with. Non-malignant neoplasms affecting the plantar part of the foot are especially rare; such tumors as occur are usually of a malignant type. The following two cases, therefore, should possess certain interest not alone from the rarity of the situation, but also from the non-malignant nature of the growths.

CASE I.—*Fibroma of Left Internal Malleolus* (observed and operated in 1914).—A woman of forty years. Personal and family history negative as regards malignancy. Seven years previous to the present examination the patient received an injury on the internal malleolus of the left ankle. About three years later appearance of a new growth was noted which continued slowly to increase in size. Pain was slight except on deep pressure. The integument covering the tumor was eczematous.

Under gas-ether anaesthesia the growth was removed and the site of its attachment thoroughly curetted and cauterized. Wound was left open for healing by granulation. Two weeks later a secondary operation was performed for the purpose of transplanting skin to repair the defect, which now showed healthy granulation. Skin was transplanted from the patient's daughter, healing perfectly.

Photographs of this case taken while the tumor was present and of the same region after removal of the neoplasm fully show the results. (See Figs. 1 and 2.) Microscopically the tumor was a myxo-fibroma. (For histological examination of removed tumor, see end of Case II.)

CASE II.—*Fibroma of Right Plantar Fascia*.—Mrs. B. E., hospital number 6827, admitted June 5, 1920. White, American, female, married, aged thirty-six, housewife. Family history negative as regards malignancy, tuberculosis, etc. Personal history negative. Menstrual history normal. No pregnancies. Previous diseases: When a child had measles and mumps.

Onset of present trouble: Patient discovered a small tumor on the sole of the right foot three years ago. It was painful, and was surgically removed.

Clinical history: When about fourteen years of age the patient ran a nail into the sole of the right foot. Ten years later a tumor began to form in this region. The growth continued, gradually increasing in size until September, 1917, when it was surgically removed. After operation soreness continued, and about six months later it was noticed that the tumor was again growing at the site of the former operation, gradually increasing in size to its present dimensions.

Physical examination: Head, neck, chest, etc., negative. Right foot: Large mass of new growth on the plantar surface of the sole of the foot. Integument unbroken (see Figs. 3 and 4). Painful to the touch (moderately), immobile. Inguinal glands and adjacent glandular structures free.

Operation, June 6, 1920, gas-ether anaesthesia. Incision around the tumor and blunt dissection of the tumor mass from the plantar fascia, to which the growth was firmly attached and apparently springing from that structure. After the bulk

of the growth was removed the fascia was curetted and cauterized. Wound left to heal by granulation.

A secondary operation was done fifteen days later for the closure of the wound by skin grafting. A section of skin corresponding in size to the defect of the sole of the foot was taken from the right supra-iliac region of the patient's husband and the defect covered therewith. Recovery uneventful.

Pathological report: Gross pathology: (see Figs. 5 and 6), a tumor, size eight cm. long, six and five-tenths cm. high, four cm. deep. Removed by operation from the plantar fascia. Gross specimen covered by epithelial tissue, color of skin. Consistence firm. On cross-section the gross specimen is divided into one large and one smaller mass.

Microscopical examination (Cases I and II): The gross histology of the tumors removed in both instances can best be judged by studying the appended photographs. Histologically the tumor masses in both cases consisted of connective-tissue cells in all stages of metamorphosis. Some were spheroidal, some spindle-shaped and some of distinctly embryonal type; some were running a parallel course while others showed a concentric disposition. Here and there soft spaces proved microscopically to be the soft variety of fibrous tissue. Blood-vessels were few; within the softer areas the vessels were more abundant. No karyokinesis; no malignant elements.

Microscopic diagnosis: Fibroma of the plantar fascia in one case and myxofibroma in the other. In the case of tumor of the plantar fascia there was every reason to suspect malignancy, from the clinical point of view, yet microscopically such was not found to be the case. Hence all precautions were observed in clearing away every vestige of the tumor tissue from the normal generous allowance for the overlying integument, and thorough cauterization with the actual cautery.

A review of the literature concerning tumors of the feet shows that fibrous tumors are extremely rare. Tumors of the sarcomatous type are those which more usually occur. A number of malignant melanotic tumors have been observed by Hertzler and Gibson<sup>1</sup> and by Stevenson.<sup>2</sup> These tumors have been variously described as chromato-phoroma, melanoma, and melanosarcoma. Hertzler and Gibson prefer to term them melanoblastomas. They are ulcerous or fungoid lesions more usually on the plantar than the dorsal surface of the foot with a tendency to recurrence if excised; they metastasize by the lymph route and are freely melanotic. They originate from the chromatophores, the stimulating factor being usually some trauma. The authors preferred to think it unwarranted to class these tumors with the sarcomata. They report eleven cases and mention several similar tumors described in the literature. The majority gave a history of trauma, this generally being a puncture from a nail in the shoe or some similar injury. Stevenson reported fifteen similar malignant melanomata occurring either on the heel or sole of the foot in natives of Bombay, India. Nearly all gave a traumatic history. In the two tumors referred to in the present report nothing was found in the histological examination which would connect them with the melanotic type.

Lipomatous tumors of the plantar surface have been reported by Tubby,<sup>3</sup> Bland-Sutton,<sup>4</sup> Du Castel,<sup>5</sup> Casali,<sup>6</sup> and Chevalier.<sup>7</sup> Both of Tubby's cases gave a history of trauma. Bland-Sutton's case was a fibrolipoma.



FIG. 1.—Tumor of foot. (See Case I.) Fibroma left internal malleolus.



FIG. 2.—Same. Three months after surgical removal.



FIG. 3.—Fibroma of right plantar fascia. (See Case II.)



FIG. 4.—Fibroma of right plantar fascia. (See Case II.)





FIG. 5.—Same. Gross appearance of tumors after enucleation.

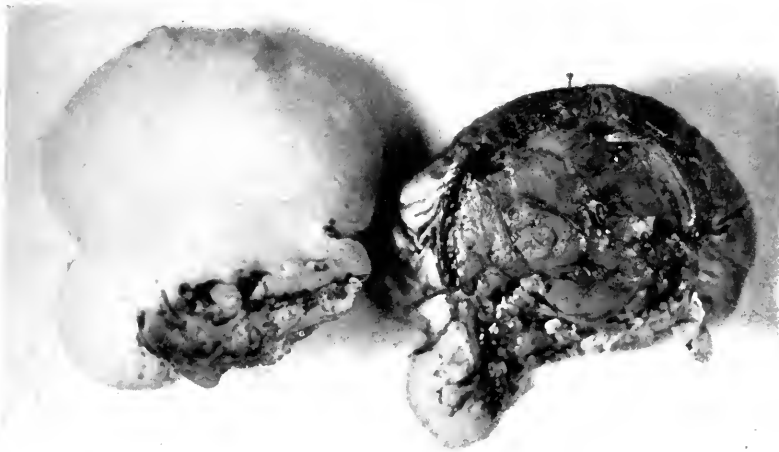


FIG. 6.—Same. Gross appearance of tumors after enucleation.



FIG. 7.—Same. Appearance of foot after transplantation of skin into bed of tumor.



FIG. 8.—Appearance of foot eight weeks after operation.



FIG. 9.—Microphotograph (low power) Case II.

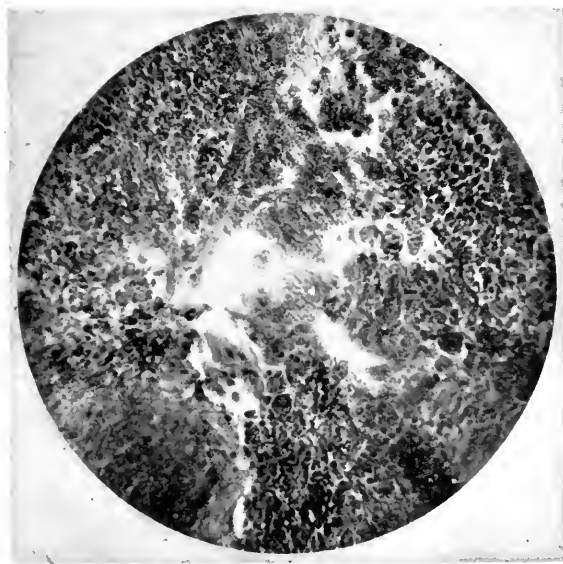


FIG. 10.—Same. High power magnification.



## FIBROUS TUMORS OF THE FOOT

In Bland-Sutton's case the specimen was found in the Museum of the Royal College of Surgeons, London. The tumor was thirty years old; on microscopical examination by Bland-Sutton he found that the tumor mass consisted of a fibrous network, the spaces between the meshes consisting wholly of fat. It may, therefore, be described as a fibro-fatty tumor. Bland-Sutton calls it a fibro-lipoma of the plantar fascia; it occupied the whole sole of the foot and amputation had been done.

Du Castel's case is also stated by him to be a lipomatous tumor with fibrous transformation. There was no histological examination. Casali reported a sub-fascial lipoma. The subject of lipomata of the sole of the foot was reported upon by Kleinnecht<sup>27</sup> in 1898. He collected seventeen cases from the literature.

Sarcomata and epitheliomata of the sole of the foot have been reported by Stevenson (besides the malignant melanomata already referred to), Heurtaux,<sup>8</sup> Jessett,<sup>9</sup> Nasse,<sup>10</sup> Steiner,<sup>11</sup> Canbet,<sup>12</sup> Morestin,<sup>13</sup> Graham-Little,<sup>14</sup> Marchand,<sup>15</sup> Gaucher and Abrami,<sup>16</sup> and others. Heurtaux's case was sarcoma of the plantar fascia.

Mermet<sup>17</sup> removed an alveolar sarcoma from the external malleolus. Duvergey<sup>18</sup> described a case of botryomycosis on the plantar surface of the foot following a traumatism. It has been confused with rodent ulcer.

Nævi have been reported by Latronche<sup>19</sup> and Landois.<sup>20</sup>

Latronche's case was one of multiple nævi on the plantar and dorsal faces of the foot and in the leg. Landois' case was in the dorsum pedis.

Fibrous tumors of the foot, similar more or less to my second case, have been reported by Houel,<sup>21</sup> Davies-Colley,<sup>22</sup> Duret,<sup>23</sup> Routier,<sup>24</sup> and Penières.<sup>25</sup> Houel's case is described as a cystic tumor the size of a hen egg; it was twenty years old, of unstated origin, situated on the dorsum pedis and surgically removed. Microscopically it was a fibro-plastic tumor. In Davies-Colley's case the patient fell and suffered a patellar fracture thirteen months previously, since which time the sole of the foot was tender and swollen. The removed tumor proved to be a fibrous thickening of the plantar fascia without any capsule. Davies-Colley thinks the cause was a laceration or injury at time of the fall. Duret's case was congenital. The tumor occupied all the sole and edges of the left foot; it was hard and ligneous but not painful. The connectival neoformation predominated in the middle layer of the derma; all the thickening appeared to be at the expense of this zone; the epidermis took only an accessory part. The tumor was removed in blocks by abrasion. The histological diagnosis was an elephantiasic diffuse fibroma. Routier's patient gave a history of a fall on the left foot twenty years before. He was told there was neither fracture nor sprain. Tumefaction appeared by degrees on the concavity of the plantar vault of the foot. A tumor of the plantar aponeurosis size six cms. x four cms. was resected and on histological examination proved to be a very vascular fibroma. Penière's case is described as a fibroma of the annular ligament of the tarsus, but as the original article is not available, I regret I can give no further particulars.

Without being exhaustive, the fairly general survey of the literature which has been made therefore shows but very few cases of fibrous tumors involving the plantar fascia.

With regard to the etiology of these cases it is to be observed that trauma is common. In the case of tumors of a sarcomatous epithelial or melanotic type the trauma is more usually a punctured wound from a nail or other pointed object. In the fibrous tumor the trauma is more frequently of a

diffuse type. However, in my second case the history is that of a nail penetrating the foot.

Resection of the tumor mass appears to have been the surgical treatment generally adopted. Steiner<sup>11</sup> obtained good results from excision and skin-grafts, and Mauclair,<sup>26</sup> in a case of rodent ulcers of the foot, also obtained a good result from excision followed by Italian graft.

The necessity for careful investigation of any suspicious looking swelling of the foot is apparent from a case of sarcoma of the foot reported in the United States Medical Naval Bulletin for October, 1920. This case was diagnosed as abscess of the foot. A small incision was made for the purpose of draining the supposed abscess but no pus was found. Three days later the patient was admitted to the hospital. At this time a small piece of tissue was removed for diagnostic purposes and the wound cauterized. There was beginning cellulitis, and a temperature of 103.8. On the following day there was swelling of the foot and leg, accompanied by marked inflammation. The inguinal and saphenous glands were enlarged and painful and symptoms of phlebitis were developing. Microscopical diagnosis, round-cell sarcoma. Amputation was refused and the patient continued to show signs of toxæmia and chest symptoms. A frank lobar pneumonia developed, which gradually cleared up. In the meantime the inguinal and saphenous glands broke down, requiring incision and drainage. The tumor grew rapidly, metastatic new growths appeared in the popliteal space, lumbar region, abdomen and right lung. Death resulted in a little less than three months after the patient was admitted to the hospital.

Two very significant and valuable points are suggested by this report; that of the necessity of thorough eradication of any suspicious neoplasm with thorough cauterization to prevent its spread, and that an acute pyogenic infection does not protect from or inhibit the malignant progress when the growth is of that type.

#### DESCRIPTION OF PLATES

- Fig. 1. Tumor of foot (see Case I). Fibroma left internal malleolus.
- Fig. 2. Same. Three months after surgical removal.
- Figs. 3 and 4. Fibroma of right plantar fascia (see Case II).
- Figs. 5 and 6. Same. Gross appearance of tumors after enucleation.
- Fig. 7. Same. Appearance of foot after transplantation of skin into bed of tumor.
- Fig. 8. Appearance of foot eight weeks after operation.
- Fig. 9. Microphotograph (low power), Case No. II.
- Fig. 10. Same. High-power magnification.

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## FIBROUS TUMORS OF THE FOOT

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# THE SURGICAL TREATMENT OF UTERINE PROLAPSE

END RESULT IN THIRTY CASES

FROM THE GYNECOLOGICAL CLINIC OF THE UNIVERSITY OF MARYLAND

BY JOHN M. HUNDLEY, M.D.

AND

JOHN M. HUNDLEY, JR., M.D.

OF BALTIMORE, MD.

THE number of different operations proposed for the cure of procidentia would indicate that no agreement has been reached as to which is the best procedure in these cases. After a trial of several different types of operations, the Watkins' has given better results than any other we have used. Our object in making this report is (1) to record our end results, and (2) to emphasize certain steps in the operation which we believe are important to obtain satisfactory results. On going over the records for the last fifteen years, forty-five cases of procidentia with fairly adequate histories were obtained. A number of other histories were found which could not be used because of insufficient data. Of the forty-five cases the end results were ascertained in thirty. Twenty-nine were cured, and one was a partial failure. The reason for this failure will be referred to later. We failed to trace fifteen. Those interested in the historical account of the developmental phases of this type of operation are referred to the article by Watkins in *Surgery, Gynecology and Obstetrics*, 1906, vol. xi, p. 659, entitled "The Treatment of Cases of Extensive Cystocele and Uterine Prolapse."

*Technic of Operation* (Fig. 1).—This picture shows outline of the incision in the anterior vaginal wall, and half-way around the cervix. The incision extends within half inch of the meatus urinarius.

Fig. 2. The bladder is now being separated from the vaginal walls and cervix. Care should be taken that the separation is begun in the proper plane. If this is done the tissues separate easily and injury to the bladder is avoided.

Fig. 3. The bladder is now retracted, when the thin fold of utero-vesical peritoneum comes into view. This fold is picked up with forceps and incised. The wound may be enlarged by stretching with two fingers if too small to allow the free delivery of the body of the uterus.

Fig. 4. After the body of the uterus is well delivered and in ante-flexion two chromic catgut sutures are passed through the tissues near the pubic arch, next through the posterior wall of the uterus near the fundus, and then through the tissues near the pubic arch of the opposite side. The sutures are now tied, and the fundus is replaced in the pelvis.

Fig. 5. The broad ligaments are now brought forward and sutured in front of the cervix. Watkins, in *Surgery, Gynecology and Obstetrics*, 1906, advocated this procedure in extreme cases only. We adopted this suggestion



in 1907, and have used it since in all of our cases, and believe it essential to insure a permanent result. To avoid dead space, and to strengthen the anterior vaginal wall, we suture the musculature and fascia of the vagina in front of the cervix with interrupted sutures of catgut. The cervix is now amputated, and the redundant vaginal flaps excised.

Fig. 6 shows the wound in the anterior vaginal wall closed, and the cervix covered with mucosa. In doing this operation we have in mind that prolapsus uteri is a hernia, and that the same principles should obtain here as are used in operating on hernias elsewhere.

Fig. 7. A perineorrhaphy is now done. The operation depicted in the drawings is a composite one, made up of points gathered from various operators. We discarded the Emmet operation some years ago for the one we are now doing, which is of the flap-splitting type. The picture shows the outline of the incision at the mucocutaneous junction.

Fig. 8. After this incision is made the vaginal wall is separated from the rectum high up on the crest of the rectocele. This accomplished, the levators are brought into reach by forcibly stretching the wound from side to side.

Fig. 9. This picture shows the levator ani muscles brought to the midline, and the sutures placed.

Fig. 10. The sutures in the levators are shown tied, and the wound is ready to be closed, as shown by the sutures in the picture. Where there is a complete eversion of the rectovaginal septum the vaginal wall must be separated from the rectum nearly up to the cervix, and the redundant flaps excised. These procedures narrow the vaginal canal to approximately its normal calibre. An ordinary perineorrhaphy will not effect a cure in the extreme cases.

Fig. 11. This picture, taken from Watkins' article, *Surgery, Gynecology and Obstetrics*, 1906, shows the position of the uterus in the completed operation.

In addition to the above procedure, in Case XIV, a laparotomy was done for the purpose of shortening the uterosacral ligaments and anchoring the upper end of the vagina. This was done by passing two rows of quilting sutures from side to side in Douglas' pouch, and then suturing it to the posterior wall of the cervix, after having first shortened the uterosacral ligaments. This was done in 1919. The senior writer thought this was original with him until reviewing the literature on the subject, when he found that D. F. Jones had had the same experience in thinking that he had discovered something new. Jones on reviewing the literature discovered, as he says, in the *Boston Medical and Surgical Journal*, 1916, clxxv, 623: "For about a year before Moschcowitz's article came out in 1912 I thought that I had made a discovery. In his paper Moschcowitz intimates that he thought he was getting out something original, but found that Waldeyer, Ludloff, Zuckerkandl, and others had described very accurately the pathological anat-

omy of the condition, and that Bordenheuer in 1902, and Quénu and Duval in 1909, had published operations very similar to the one he advocated." The reason we adopted this method was because the result in Case IV, alluded to previously, was not a success. In this case the rectocele recurred. With this experience in mind, when consulted by Case XIV, which was of a like type, we decided to anchor the upper end of the vagina, having in mind that fixation of the upper end of the vagina would prevent recurrence of the rectocele. At the time that this operation was done we did not appreciate the influence a deep cul-de-sac exercised in the production of prolapse of the vaginal walls. Only after reading the explanation of Jones did we fully appreciate the part played by the deep cul-de-sac in these cases. In the article above referred to Jones states that the closure of the cul-de-sac allows the weight of the intestines and the intra-abdominal impact to fall on the uterus, bladder, and anterior abdominal wall, while the deep cul-de-sac allows this impact and weight of the intestines to fall on the anterior rectal wall, or posterior vaginal wall, thus exerting a downward pull on the uterus which helps to increase the prolapse. A congenitally deep cul-de-sac and faulty development of the pelvic fasciæ is thought by many to be the cause of procidentia in virgins.

## REPORT OF CASES

This type of operation is applicable in women who have passed or are approaching the menopause. It should not be done on women in the child-bearing period unless the tubes are resected.

In this series twenty patients had passed the menopause, and five were approaching it; their ages varying from thirty-eight to fifty. The ages of the five remaining cases were from thirty-one to thirty-seven. The reasons for doing an interposition operation on this group—thirty-one to thirty-seven years of age—were as follows: A suspension and perineorrhaphy had been done in Case XVIII some time previously with return of the prolapse. There was a complete rolling out of the vagina and prolapse of the uterus in Cases VII and XIII, and it was thought that a good result could only be obtained by this type of operation. The two remaining cases showed extensive relaxation and procidentia. Both were hard-working women, and it was thought that a satisfactory result was more important to them than bearing more children. Of the thirty cases herewith reported, twenty-eight were married and two single. Twenty-seven had had children, the number varying from one to nine. Two cases, IX and XXIX, were single and had had no children. One patient, Case VIII, was married, but had never been pregnant. She was a dwarf with a kyphosis and lateral scoliosis. One of the objections to the interposition operation offered by some men is the resulting cystitis which occurs in a large proportion of their cases. We have not had this complication. Thirteen of the patients voided after the operation, and of the remaining seventeen the majority had to be catheterized over a period of only one to four days.

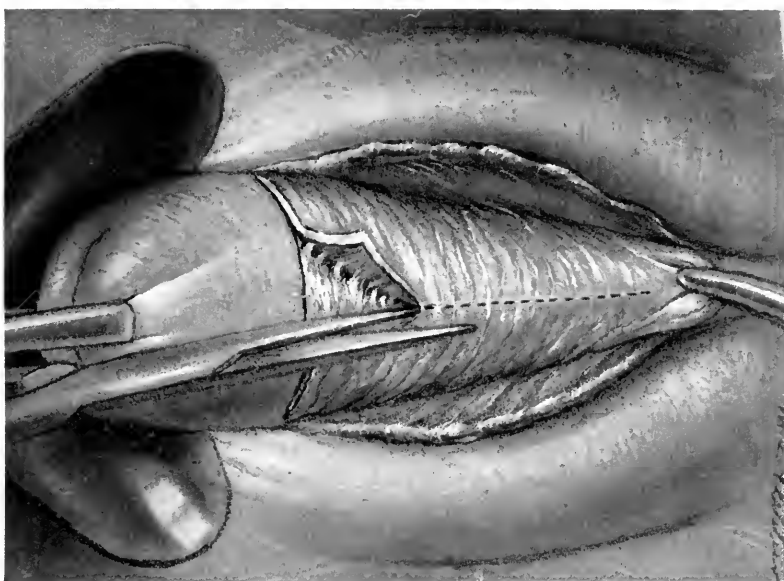


FIG. 1.—Incision in anterior vaginal wall is here shown.



FIG. 2.—The bladder being separated from vaginal walls and cervix.

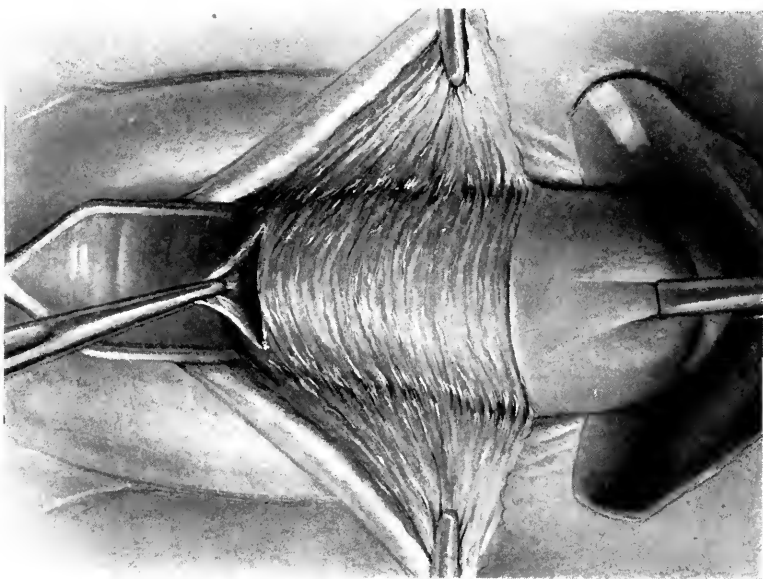


FIG. 3.—Opening in uterovesical peritoneum.

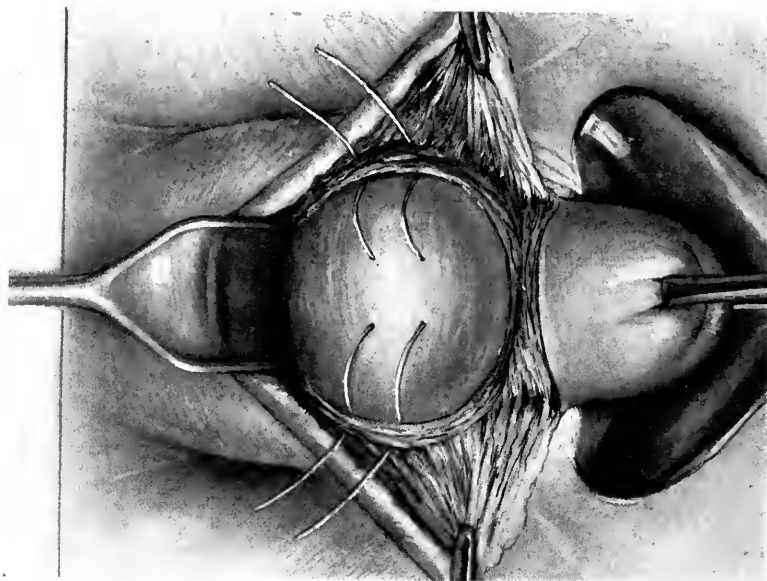


FIG. 4.—Fundus anteverted with sutures inserted.

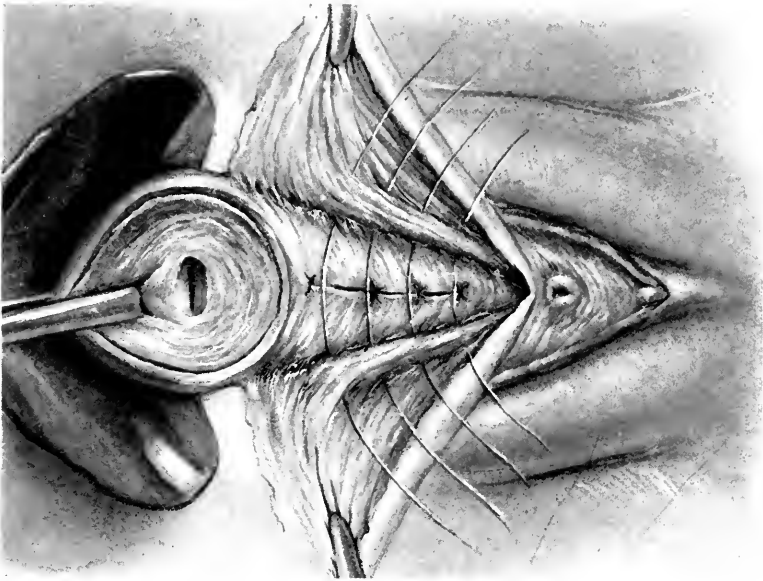


FIG. 5.—Broad ligaments sutured in front of cervix: cervix amputated. Vaginal musculature and fascia sutured in separate layer.

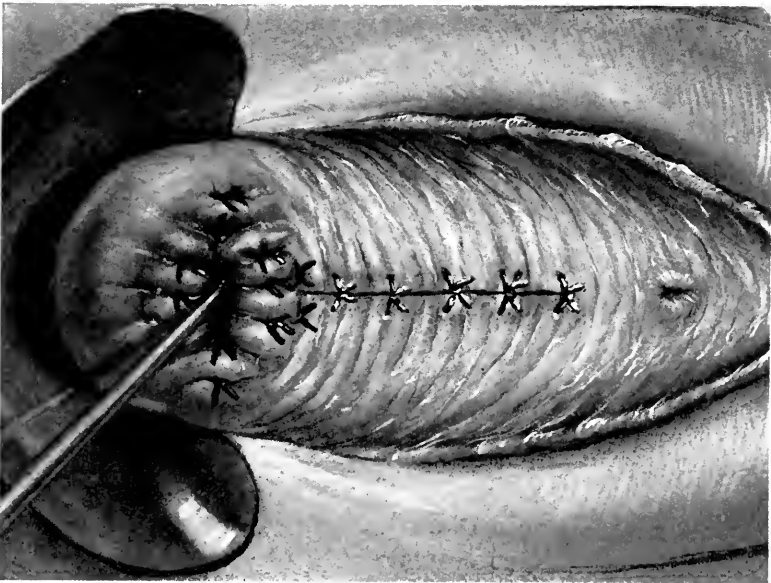


FIG. 6.—Wound in anterior vaginal wall closed and cervix covered with mucosa.

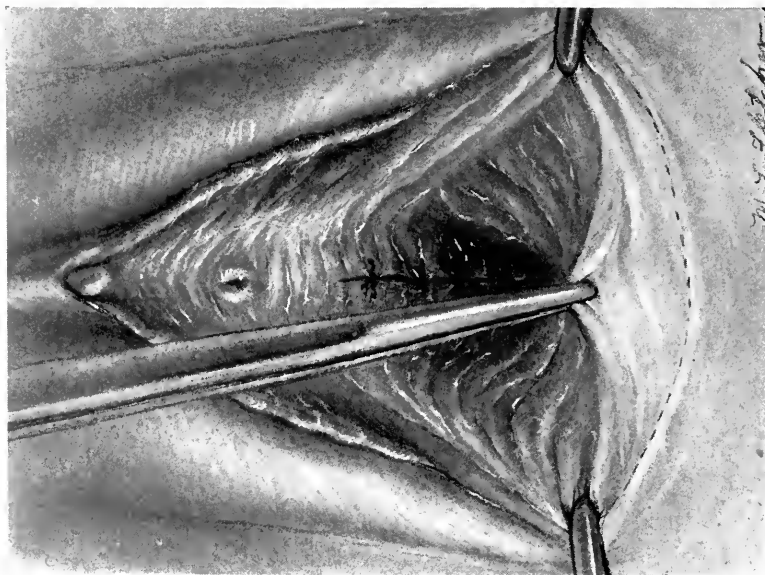


FIG. 7.—Outline of incision at mucocutaneous junction.



FIG. 8.—Vaginal wall being separated from rectocele.

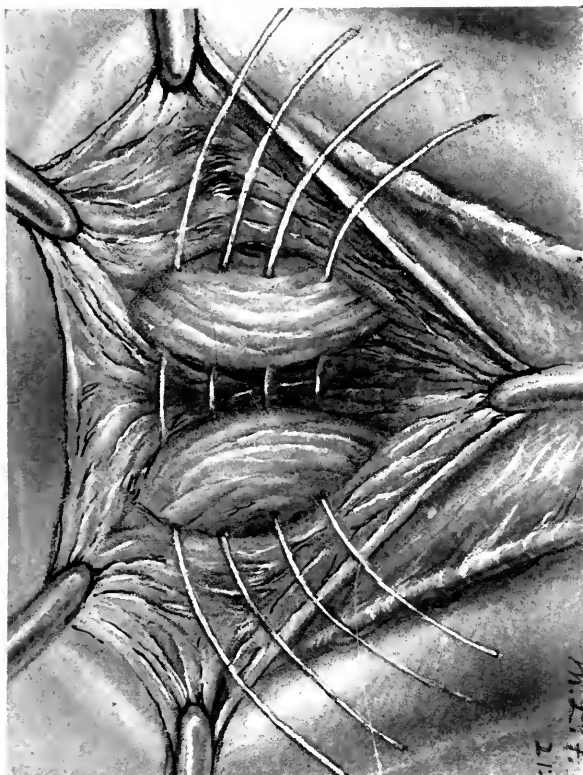


FIG. 9.—Levator ani muscles brought to midline, and sutures placed.

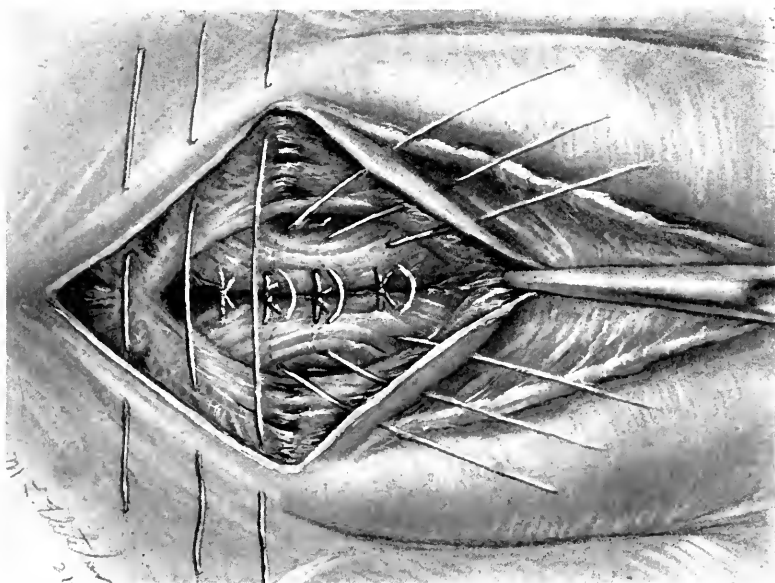


FIG. 10.—The V-shaped sutures are shown, and wound is ready for closure.

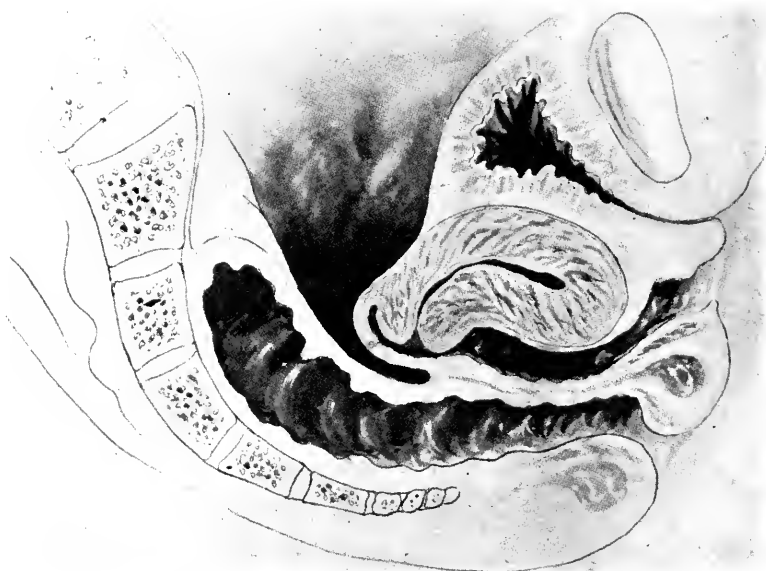


FIG. 11.—Sagittal section showing uterus in its new position.



## THE SURGICAL TREATMENT OF UTERINE PROLAPSE

Case number twenty-four could never void while in bed, and patient number eight before operation complained of frequency and dysuria, and following operation her symptoms became more severe. Her bladder was instilled with a solution of nitrate of silver, one to a thousand, daily, which gave great relief. Several of the patients, seven, fifteen and twenty-two, complained of frequent desire with difficulty in starting the flow, and having to replace the uterus before it could be accomplished, voided soon after the operation. This demonstrates very clearly one of the objects of the operation, that is, the elevation of the base of the bladder by the fundus of the uterus. It is thought by some that separating the bladder from the cervix and vaginal walls causes changes in the bladder mucosa which lead to chronic cystitis. This has not been our experience. Cystoscopic examination has been made on several patients following operation and no evidence of cystitis could be made out. The base of the bladder could be seen pushed up by the body of the uterus. Average duration of stay in the hospital following operation was about eighteen days; one patient, on account of infection in perineum, was confined to the hospital forty-five days. She finally made a satisfactory recovery. A complete cure was obtained in all of our cases except one. This case, number four, which was a partial failure, might have been cured if the cul-de-sac had been treated as described by Jones, and then anchored to the posterior wall of the cervix. The outstanding symptoms were found to be prolapsus, leucorrhœa, not infrequently bloody, due to irritative ulceration of the cervix; backache and headache; bearing-down feeling in the pelvis; constipation and hemorrhoids. Frequency, dysuria and difficulty in starting the flow were prominent symptoms. All patients on pelvic examination showed cystocele, rectocele and procidentia. The period of time which has elapsed since operation is as follows: 1907-1911, eight cases; 1911-1915, seven cases; 1915-1919, six cases; 1919-1921, nine cases.

### CONCLUSIONS

1. The interposition operation gives better results than any other operation we have used in the extreme cases of uterine prolapse.
2. Of the thirty cases there has been no return of the procidentia. In one the rectocele returned. She reported that she was sufficiently comfortable, and did not wish to be operated on again.
3. A small percentage of the patients complain of some bearing down and discomfort in the bladder after doing a hard day's work.
4. In cases with marked eversion of the vaginal walls, associated with complete uterine prolapse, a cure can be effected by plicating the cul-de-sac of Douglas, and anchoring it to the posterior wall of the cervix, together with shortening of the uterosacral ligaments.

## NEW MECHANICS IN BONE INJURIES

By HARVEY C. MASLAND, M.D.

OF PHILADELPHIA

FROM the remote past, surgeons have recognized that the indications in fractured long bones are to correct the deformity by traction and provide a fixation device to retain the injured member in its normal position.

Traction has followed two general methods. In the one by manual manipulation and possibly mechanical appliances reduction has been attempted and then fixation apparatus has been applied. In the other, the limb has been placed as nearly as possible in normal alignment and traction has been exercised by cord pulley and weights applied in such a way as to give the direction of pull indicated.

Many fractures are of such a type that by the intelligent application of manual manipulation they can be replaced perfectly and retained in position by a simple splint.

There have been various mechanical devices to increase traction power. The most modern are several models of tables all designed on the one principle of fixing the part above the fracture and by cranked screws exercising traction on the distal part of the fracture. Usually in this latter method plaster-of-Paris is applied while the limb is maintained in this extended position. According to this plan of treatment the surgeon uses his judgment as to whether he has secured good alignment and replacement. Should the X-ray prove this to be not the case, he either decides that it is as good as he can secure or he makes a second attempt. He must then remove his cast or other dressing and working from the beginning again endeavor to secure a better position. Fluoroscopy has been used but is dangerous and most often impracticable. The judgment of the best is never infallible.

Traction by pulleys and weights is much more uncertain. In practice men are prone to adopt an arbitrary weight and the replacement is practically never more than relative.

The introduction of the turnbuckle was a distinct departure from the methods in general use. It offered a definite control over the amount of extension and without sacrificing results already attained permitted further adjustment to meet the deformity still present, as shown by the X-ray. The turnbuckle offered, however, was very inadequate to meet the needs of general application. It had unwieldy anchor ends to be imbedded in plaster above and below the fracture. These ends were difficult to make stable even on the femur, and even here were limited practically exclusively to fractures in the middle third. Further, they could give extension but were not satisfactory as to maintenance of alignment and fixation. Torsion of the limb could readily occur.

The four types of splints presented are adapted for use in the fractures

of any of the major long bones of the body. As all parts are interchangeable, many modifications are possible. The splints have conveniences so that the surgeon can build a splint according to the needs of the individual case. It is needful to say that these splints involve a new conception of the treatment of fractures. They make larger demands on the mechanical ingenuity of the surgeon. They also require a greater attention to detail and what might well be called drudgery. The results attained have been striking, and much greater than my expectations, particularly in treating rebellious fractures. In all acute fractures in the continuity of the long bones of the limbs the intelligent application of these splints, while the fractured ends are still free, will bring the parts to their normal relations. The cases to be reported will demonstrate that even in delayed cases most remarkable results have been obtained.

*Splint Mechanics.*—These splints are all built on the one basic principle—a rigid anchorage above and below the fractures sufficient to bear comfortably all the strain needed to give the requisite extension. Splint arms extend from these fixation supports over the fractured area, overlapping each other to an ample degree. The overlapping arms can be clamped together or slide free in an encircling sleeve. Turnbuckle devices are mountable on these overlapping arms and give the desired extension. When this is gained the arms are clamped tight in the sleeves. Should the X-ray show still further correction is needed, the turnbuckles are remounted, and a definite measured extension to meet the X-ray demands can be made. It is possible to make the correction to a nicety. The fixation is absolute.

It is imperative that the operator learn how to utilize the various parts of the body to meet his mechanical needs. Whether it be the buttock ring and trunk arm of the femur splint, the shoulder girdle of the humerus splint or the various plaster-of-Paris applications, he must study how best to secure the most comfortable and the most complete support. Increased knowledge as to this will come with experience. In an earlier publication (*ANNALS OF SURGERY*, April, 1921) I advised making the buttock ring several inches over the tape measure circumference to allow for the padding. This was a mistake, as it brought the inner rim on the anterior surface of the pubis. I now make it as near as possible the tape measure circumference. The padding rests more firmly on the soft tissue and the iron bears against the antero-lateral aspect of the pubis, a much less irritating position. In the delayed thigh case here reported I used possibly a hundred pounds pressure and yet there was no tissue injury and a quite bearable pressure complaint.

In the application of the plaster the bandages used are comparatively narrow and quite wet, so that the layers will be well incorporated. No padding should be used. The plaster should not be drawn to impair circulation, but should fit the parts intimately. It would be foolhardy to overlook the possible danger of plaster, particularly in forearm fractures. A plaster applied early in forearm fractures will undoubtedly aggravate the later swelling. Most careful attention should be given that the constriction does not

pass safe limits. In severe cases of swelling the case is slit and forcibly sprung open, a cork is placed between the cut edges to maintain the separation. This applies particularly to the plaster on the upper forearm. It can be drawn together as the swelling subsides. Even though it might be necessary to remove the casts, we have gained our reduction, and the retention for the time the plaster was in place. In one of my cases there was an œdema and congestion that prompted me to remove the casts on the fourth day. The tissues under the casts were in good condition and the intervening area of swelling subsided without incident.

To resume, we get support from an increasing circumference and none from a receding circumference. Thus in the leg plaster for a thigh splint, we have support from the knee-joint to the maximum circumference of the calf and none from this point till we reach the swell of the ankle.

Where the edge of the plaster might chafe the skin as on the foot, a small strip of artificial leather laid next the skin and held by the plaster will prevent chafing. Chafing should be guarded against. It should be noted at its beginning and properly corrected.

In the plaster glove for Colles and other forearm fractures, the thumb should be held by the plaster in moderate abduction. This gives a greater wedge-shape to the hand and so gives better support. It would be impossible to note all the little details for the different splints, but these mentioned serve to indicate the thought that should be applied elsewhere.

CASE I.—Figs. 1, 2, 3 show the accuracy with which an impacted Colles fracture was brought to normal position. The typical deformity was marked. Care was taken that the small plates were imbedded in the plaster on the dorsum of the hand and in the plaster on the upper forearm in true alignment. The overlapping plates were bent using the well forearm as a model. When these are attached to the imbedded plates, the turnbuckle assembly applied and extension made, the deformity disappears without any pain. The retention is absolute. The pictures show the advantage of complete X-raying. This was the right arm and I extended till the forearm was a shade longer than the left. The X-ray showed still about  $\frac{1}{8}$  inch impaction. The turnbuckle was reapplied and the perfect reduction of Fig. 3 secured. Convalescence uneventful with perfect restoration.

It cannot be emphasized too strongly that the time to secure perfect replacement is while the bones are freely movable.

CASE II.—Figs. 1, 2, 3, 4 show how much benefit can be secured by this plan of treatment even after considerable delay. I saw this case thirteen days after the injury. Fig. 1 shows the comminution (six pieces) and the separation of the parts. The patient was a Pole, thirty-seven years of age, who had no intelligence where discomfort or pain was concerned. He gave the history of having thrown his sand bags and weights on the floor and thrashing over the bed. The deformity was greater than at the time of the injury. The tissue organization that can occur in thirteen days made me pessimistic as to bone union. With the comminution shortening and mental qualities of the patient an open operation was doomed to failure. My hope was to lessen the shortening, improve the alignment, gain bone union of the fragments and later do an open operation on the main shaft ends. The patient was so unmanageable that I had to replace the thumb screws with machine screws tightened with pliers so that he could not loosen them.



FIG. 1.—Case I. Note deformity and impaction.

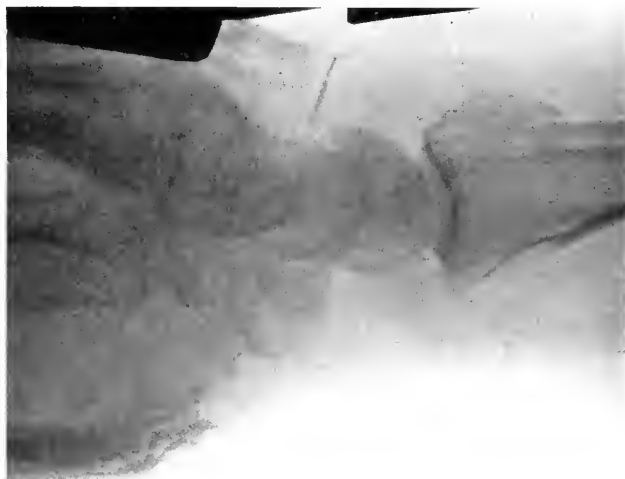


FIG. 2.—Case I. Impaction not completely reduced.



FIG. 3.—Case I. No impaction and no deformity

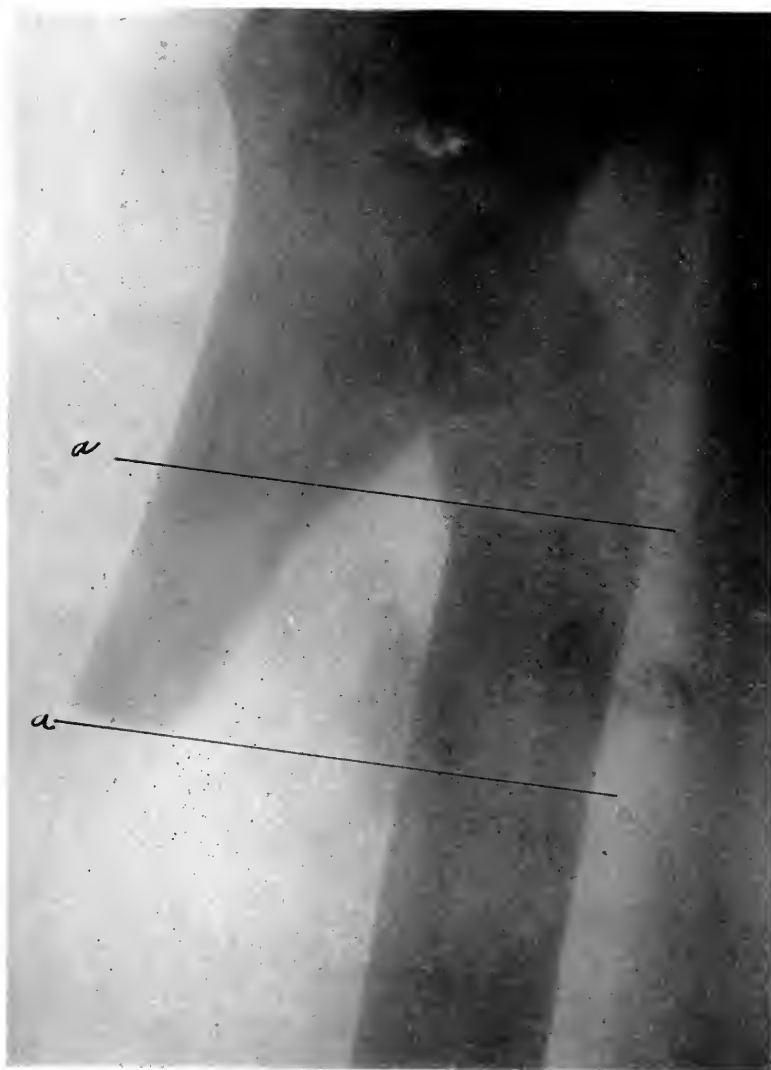


FIG. 4.—Case II. Note the free lying fragments and the angulation. Thirteen days after injury.



FIG. 5.—Case II. Note closer approximation of the fragments, the better alignment and the reduction of the shortening as shown by parallel lines on Figs. 1 and 2.





FIG. 6.—Case II. Heavy callus and good function.



FIG. 7.—Case II. Lateral view of Fig. 3. Both six weeks after application of Masland splint.

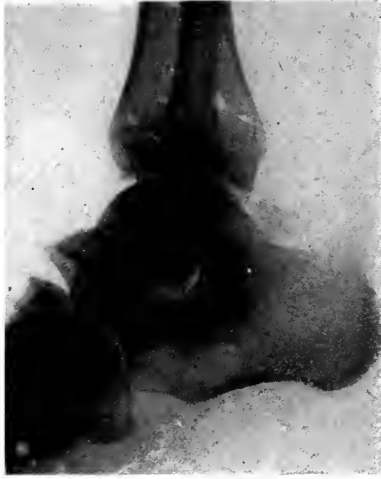


FIG. 8.—Case III. Separation at the time of injury.

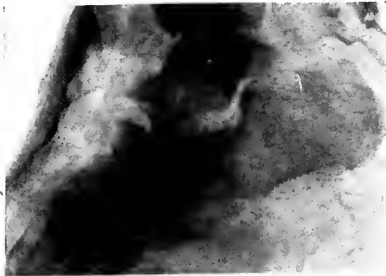


FIG. 9.—Case III. Twenty-three days after injury. No improvement in dislocation.



FIG. 10.—Case III. Unfortunately reduction apparatus removed or displaced. Note almost complete reduction of dislocation.

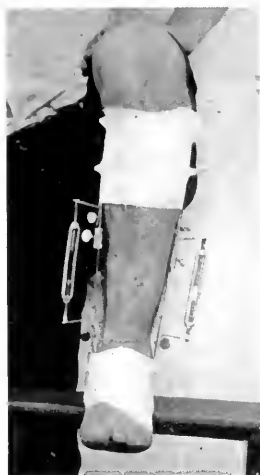


FIG. 11.—For fracture of lower half of leg.



FIG. 12.—Arm splint.



FIG. 13.—For Colles fracture.

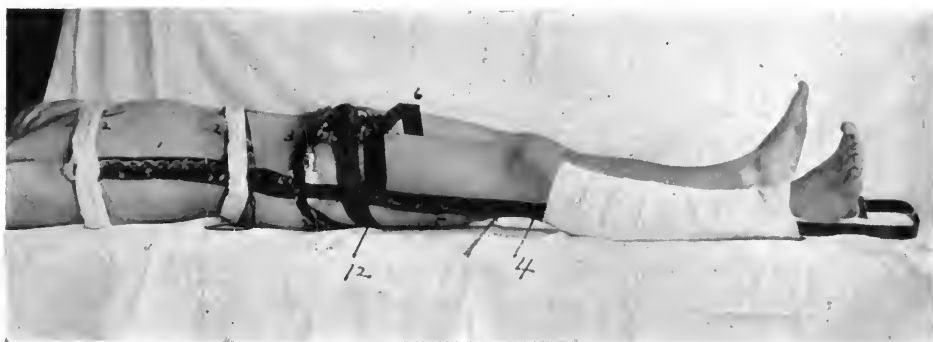


FIG. 14.—Thigh splint.

Only experience could tell me what he could stand. I applied extension to what I felt was the limit. The first leg plaster slipped and started to chafe the tendo Achillis. It was replaced promptly and gave no further trouble. There was no chafing whatsoever from the buttock ring. Only a positive fixation apparatus would have been of any value. The stretch of the tissues after thirteen days in the thick part of the upper thigh as shown by the parallel lines on Figs. 1 and 2 shows the extending power of the turnbuckles. The heavy callus of the union is far from an artistic result, but Nature will mould this to better lines in time and he has a good serviceable limb slightly over an inch short.

While these splints are devised primarily for fractures of the major long bones, the ingenious surgeon will find parts useful in the treatment of other conditions. In fractures of the metatarsals and the metacarpals and some phalangeal fractures single or multiple, two of the smaller strips can be made into a rigid T. The stem is imbedded in plaster on the foot or hand above the fracture and extension made from the cross-arm to the phalanges.

CASE III.—Figs. 1, 2, 3 show a rare case of downward dislocation of the scaphoid and cuboid from the astragalus and the os calcis. I saw the case twenty-three days after the injury when Fig. 2 showed no improvement over the original injury. Several thoughts arise from the contemplation of these pictures. We should remember that the force to replace a part with its torn ligaments is not as great as the producing force. This was quite capable of immediate complete replacement. In holding a limb at what we think is the right position and applying plaster how often the X-ray shows a disheartening result. Then it rests with the surgeon whether he will repeat the whole process or conclude that it is the best that can be done. After twenty-three days immediate forcible replacement is impossible as the bone space is filled with new tissue. The benefit to be derived from elastic flexion occurred to me. A plaster sleeve was placed around the leg above the ankles with a posterior projecting piece extending down and around the heel to prevent its forward movement. A shaped iron strap was imbedded in this plaster with the eyeletted ends exposed. A strip similarly shaped to the foot sole was imbedded in plaster around the metatarsals with the ends exposed. Elastic bands on each side producing dorsal flexion to the limit of endurance were stretched between the opposing eyes. These were worn for four weeks with the result as shown in Fig. 3.

The few cases here shown warrant the conclusion that a more painstaking study of traumatic bone lesions, a more thorough grasp of mechanical methods available, and a degree of attention to the details of care of these injuries will yield results far in advance of what is now considered possible. The results of treatment of bone injuries should closely approach those secured in soft tissue injuries.

The great extension power of this splint that can be borne with comfort is better understood when we compare its mechanics with the modern traction table, the most powerful equipment now used. In this table a prop rests against the symphysis pubis. There is sensitive skin in this region and the support is a one-point support to the side of the femur. The other leg must be anchored to prevent undue tilting of the body. The traction is made by a loop around the foot connected with a screw. It is not practicable to

make a band that would press uniformly on the dorsum of the foot and the heel. There is consequent linear pressure on narrow skin areas. I am confident that anything like the traction exerted on this leg would have torn the skin of the foot. In this device the buttock ring fits snugly against the skin throughout its circumference, braced at three points against bone, the pubis, the ischium and the ilium. The femur is in the centre of this ring. The plaster on the leg utilizes every support point from the knee-joint down. There is absolutely no padding, a pernicious thing for this type of mechanics, and the pressure is uniformly distributed.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held February 6, 1922*

The President, DR. JOHN H. JOPSON, in the Chair

## BONE TRANSPLANTATION FOR CYST OF TIBIA

DR. JAMES K. YOUNG presented a young woman, age eighteen, who at the age of six was kicked in the left ankle; two months later the lower end of the tibia was swollen. No surgical treatment until three years ago, when patient was operated on, the lower end of tibia being scraped. She came under the reporter's observation three years ago. X-ray showed a bone cyst of the lower end of the tibia. She was subjected to operation June 5, 1920, at the Polyclinic Hospital. The cortex of the tibia was found thinned out, resembling an egg-shell. Wall lined with thick capsules. The walls of the tibia were equally distended in all directions. A bone-graft from the opposite tibia was implanted. There was no post-operative hemorrhage and no pain since operation. One year after the first operation, the tendo Achillis was subcutaneously divided. Since that time there has been a perfect result. Recent X-rays show the bone transplant in place.

## DISARTICULATION OF THE HIP-JOINT FOR PERIOSTEAL SARCOMA

DOCTOR YOUNG presented a boy, aged sixteen years, who was admitted to hospital December 15, 1920, for pain in knee. No history of trauma. When operated upon, January 10, 1921, periosteal sarcoma was found in the middle of left femur involving the soft parts and the shaft above the internal condyle. Complete disarticulation of hip and amputation was done. Assisted at operation by Doctors Elmer and Cooperman. Laboratory diagnosis: spindle-cell sarcoma, some giant-cells, extensive necrosis, some highly malignant cells. Examination of the lung, November 8, 1921, no evidence of metastatic sarcoma, no evidence of disease about the shoulder-joint. On account of malignancy one tourniquet was applied at the upper border of the tumor, a long rubber tube was also applied above the pins. The femur was sawed off below the trochanter; amputation, no deep sutures were used. The time of operation was reduced, patient had no shock at operation, but two and a half hours later he had shock, but after the first six hours his convalescence was uneventful. He is now in perfect health.

DR. A. P. C. ASHHURST asked why Doctor Young sawed the diseased bone through first and then enucleated the upper end, instead of taking it out in one piece. By Doctor Young's procedure there was danger of contamination of the wound; his own experience had been that in patients where there is danger of spreading infection, tumors, or gas gangrene, it

was better not to use the Esmarch band, but to amputate by dissection. This was not as hard as it seemed, if one cuts down anteriorly, then ligates the common femoral, just below Poupart's ligament, and then ligates the superficial and deep femoral just below and divides the arteries between the ligatures. If the patient is kept in the Trendelenburg position all this time, the venous blood will run down the limb into the trunk. The common femoral vein can then be ligated and the joint opened. Then, as to diagnosis, there were some things he would like to ask. As to the diagnosis of "spindle-cell sarcoma," there were some sceptics like Bloodgood, Ewing and Codman, who have been making a registry of all these bone sarcomas. They want reports of all cases of bone sarcoma that are now alive; they want sections sent them, X-ray reports, etc., and they supply a form which can be filled out and which gives them the information they desire. He desired to know whether these observers agreed with Doctor Young that this was really a case of sarcoma.

DOCTOR YOUNG replied that he had sent all the information mentioned to Dr. E. A. Codman, of Boston, that a slide had been sent, also a specimen. He sawed through the bone first because he thought it simplified the operation considerably. He has always been impressed with the great ease and safety of the secondary operation, *i.e.*, secondary amputation of the hip-joint, which he believes is far superior to the primary amputation. He remembers the paper of Morton, published in the transactions of the Pennsylvania Hospital, with photographs of three patients sitting side by side, each having had amputation of the hip-joint. He was impressed when he found out that these were all secondary amputations. It is the removal of the bone which gives the shock; if one can divide the operation in two, it shortens the time of operation and diminishes the shock. In regard to spreading malignancy, he tried to prevent this by using the extra Esmarch band, which saves a little blood; also the long tube above the pin was very satisfactory. He thought the ideal operation to be amputation high, dividing the bone, and then disarticulating.

At one time since operation patient had tuberculosis of one lung. He spent a number of months in the pines of New Jersey, since which time there had been no evidence of the disease.

#### WILLEM'S TREATMENT OF SEPTIC KNEES

DR. MORRIS BOOTH MILLER presented a man, thirty years of age, who about thirteen months ago ran a needle into the outer surface of the leg, just below the knee-joint. The needle was broken off. In the attempts to remove it the wound became infected, and a few days later the joint surfaces became involved in a streptococcic infection of considerable severity. The treatment consisted of bilateral free incisions into the joint followed by systematic mobilization. He was in the hospital about three months. The case is presented as showing perfect functional recovery. There is full range of motion, full strength of the limb, and no resulting painful phenomena.

## RESECTION OF THE SMALL BOWEL FOLLOWING A GUNSHOT INJURY

DR. W. ESTELL LEE reported the case of a boy, fifteen years of age, who was admitted to the Pennsylvania Hospital, January 1, 1922, complaining of a bullet wound of the abdomen.

On the anterior wall of the abdomen there was a small bullet wound about two cm. to the left and one cm. below the umbilicus which traversed the left rectus muscle. The abdomen was quite tender in this region, but there was no definite rigidity. No peristaltic movements could be heard by auscultation. There were no evidences of either free fluid or air in the peritoneal cavity.

The boy was not uncomfortable and there were no definite signs of shock. Three hours after the accident had occurred, an exploratory laparotomy was done by Doctor Lee.

A modified left rectus incision was used, excising the track in its central portion. On opening the peritoneal cavity a small loop of gut which was directly underlying the penetrating bullet wound was exposed. It proved to be a portion of the ileum in about its middle third. In this loop a total of eight perforations had occurred all within the distance of seven inches. Most of the perforations had been fairly well walled off by omentum and there was little or no soiling of the peritoneal surfaces. No other injury to the bowel or other viscera was found and the bullet wound of exit from the peritoneal cavity was not located.

Resection of this portion of perforated gut was done. A piece of ileum twelve inches in length was removed and an end-to-end anastomosis done. The abdomen was closed without drainage.

*Subsequent Course.*—One week following the operation the boy started to run some temperature and shortly afterwards a small mass developed directly beneath the operative incision. This was opened and a small amount of pus evacuated. Apart from this, his recovery was uneventful and fairly rapid. He was discharged from the hospital in good condition twenty-five days after admission.

## SPONTANEOUS LATERAL VENTRAL HERNIA

DR. JACKSON K. HOLLOWAY read a paper with the above title, for which see vol. lxxv, page 677.

## HARELIP AND CLEFT PALATE DEFORMITIES

DR. W. B. DAVIS read a paper on the above subject, for which see August number ANNALS OF SURGERY.

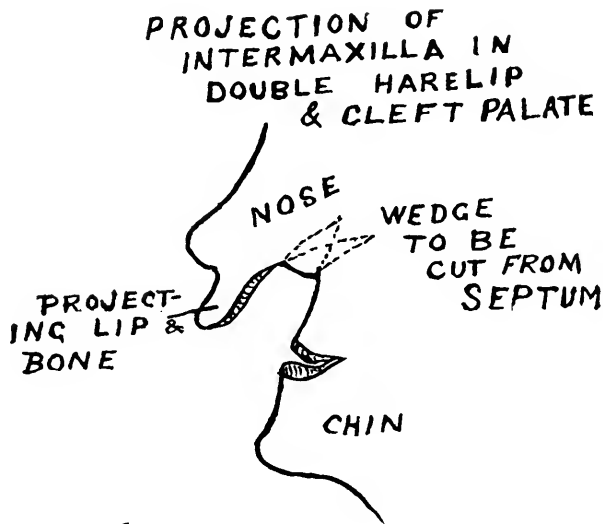
DR. JOHN B. ROBERTS, in discussing Doctor Davis' paper on harelip and cleft palate deformities, approved of early operative treatment, followed by careful training in speech by some one experienced in developing the proper use of the palatal and pharyngeal muscles. A long period of such instruction by the mother aiding the teacher may result in overcoming to a considerable extent the disability, due to the shortness of the soft palate even after the cleft is closed by operation. This will occupy years and should be started in infancy. He would like to have heard Doctor Davis tell how he closed the double clefts of soft and hard palate and lips. These are



the cases which have given Doctor Roberts great trouble. He usually closes first the alveolar process with wire and later the lip with silkworm gut. He is rather inclined to leave the palate itself until the child is a few months old, using then for the hard palate the Langenbeck method, the Lane upset-flap method or modifications of these operations. It is essential to separate from the posterior edge of the hard palate the nasal mucosa and the fibrous sheet of attachment, to let the velum drop towards the tongue.

The parents dislike the conspicuous part of the deformity so much that he likes to get the nose, lip and alveolus corrected early, even if they will require subsequent modelling later.

The protrusion of the intermaxillary bone should be corrected first of all in complicated clefts of lip and palate. This usually requires osteoplastic



*Diagram 1*  
*Replacement of Intermaxilla.*

replacement. The intermaxilla should never be removed; it must be retained and replaced to restore the dental arch.

When the hard palate is closed there is sometimes left a small opening behind the incisor teeth running from the mouth into the nose. Lane, he believes, sometimes anticipates this event by allowing the pieces trimmed from the edges of the labial cleft attached at the nostril. These two strips are turned under the lip of the baby, sutured together, and tucked up to close the floor of the nostril back of the incisor teeth. The fissure in the upper lip is then sutured; and the small nodule behind it is of service, when the uranoplasty is performed later to close the roof of the mouth.

Doctor Roberts with lantern slides then showed irregular methods of making flaps and closing the hard palate. These he had found useful in his own work.

"APRON" FLAP FOR LENGTHENING SHORT VELUM OR CLOSING CLEFTS, USING INTRANASAL SUTURE

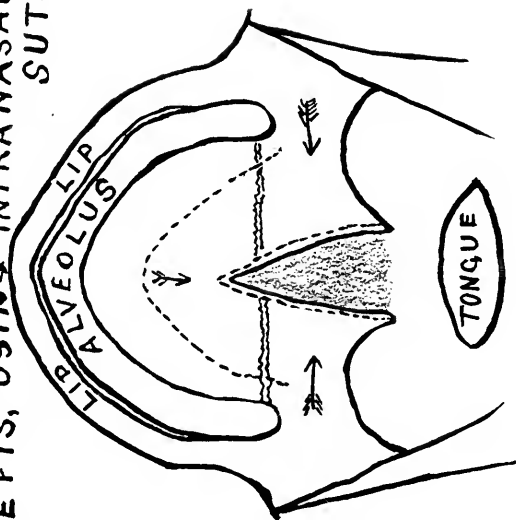


Diagram 3  
Incisions for Double Cleft  
of Velum.

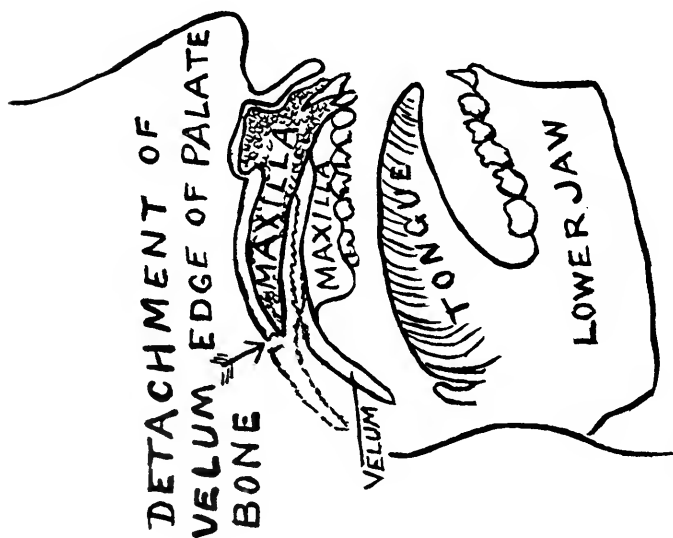


Diagram 2  
Cutting Velum from Edge  
of Palate Bone

“APRON FLAP & INTRANASAL  
SUTURE”

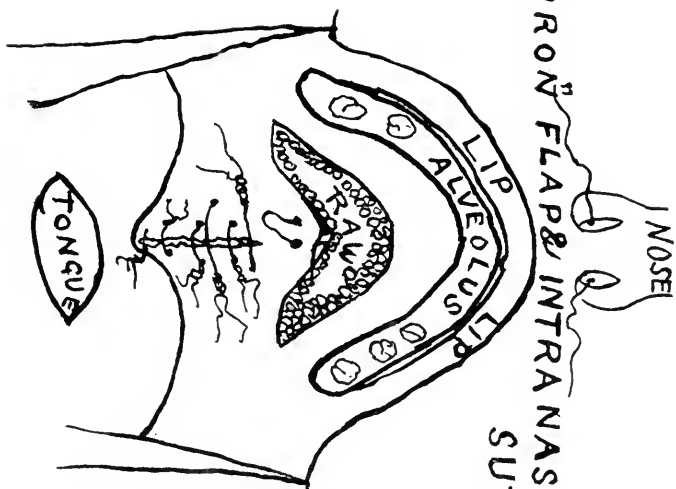


Diagram 4  
Operation for Double Cleft  
of Velum

An Unusual or  
“BRIDGE” CLOSURE  
WITH ANTERIOR AND  
POSTERIOR FLAPS

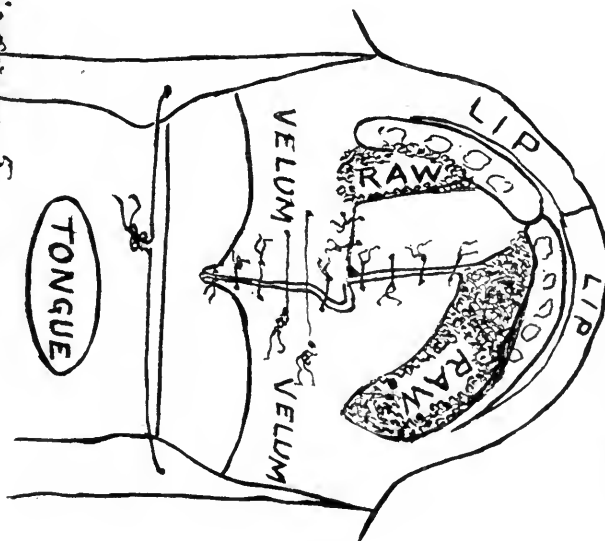


Diagram 5  
Closure of a Right Cleft

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting Held March 8, 1922*

The Vice President, DR. EUGENE H. POOL, in the Chair

## THE FORMATION OF A THUMB FROM THE FIRST METACARPUS

DR. H. H. M. LYLE presented a man who was first admitted to his service at St. Luke's Hospital, January 6, 1913. He was then nine years of age, and a wheel of a trolley car had run over his hand (Fig. 1). He was shown before this Society in 1914. (See *ANNALS OF SURGERY*, vol. lix, May, 1914, p. 767.) Shortly after demonstrating this case to the Society, and before the plastic work on the hand was finished to the surgeon's satisfaction, he moved to Chicago. Three weeks ago he returned to New York and again came under observation. He tells that he used the hand steadily, and that he is a professional chauffeur.

A comparison of the photographs (Figs. 1, 2, 3, and 4) shows that there has been considerable functional and anatomical improvement from the report of nine years ago. The original X-ray (Fig. 1) shows, besides other serious injuries, a separation of the epiphysial cartilage of the first metacarpal. On the X-ray (Fig. 3), taken two weeks ago, the metacarpus now looks normal. When he left New York nine years ago an excision of the excess of fat from the dorsal flap that had been grafted from the abdomen was planned. On his return two weeks ago, this original plan was carried out. The power of grasp which he now has is very gratifying. In addition, Doctor Lyle exhibited photographs of two other similar cases, and referred to a fourth, in which a stub of a metacarpus was developed into a useful thumb.

## THE TREATMENT OF HAND CONTRACTURE

DR. H. H. M. LYLE presented a man who entered his service at St. Luke's Hospital, March 22, 1921. Six months previously he had been struck on the back of the right hand by a brick, and sustained a lacerated wound on the dorsum of the hand. He entered a Sister hospital, where his extensor tendons were sutured; the wound became infected, and he was told that three of his tendons had sloughed out. The wound healed in two months, the hand was stiff and painful, and he could not flex any of his fingers. He was treated for four months with massage, baking and hydrotherapy, without any appreciable result. He was then referred to St. Luke's. Figure 6 shows the condition of the hand on admission. The wrist can be slightly flexed; no flexion possible at metacarpo-phalangeal, or at first inter-phalangeal joints. The thumb cannot be apposed to other fingers; slight flexion of terminal phalanges. There is wide, transverse, adherent,



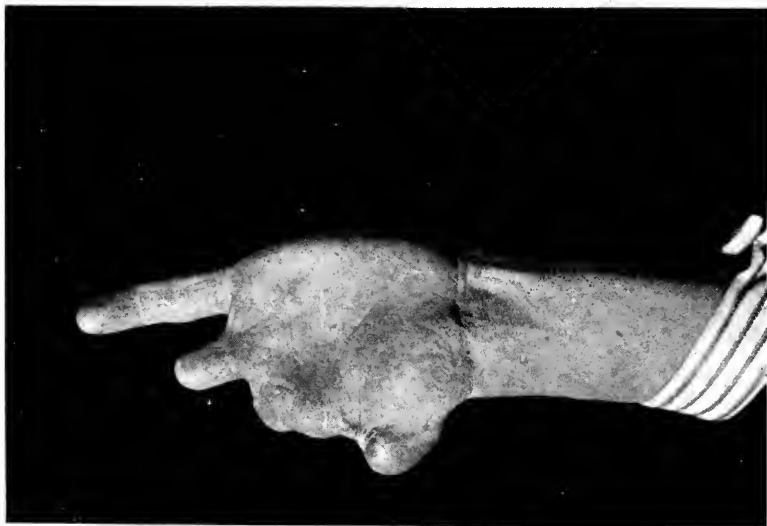
FIG. 1.—X-ray of original injury, June 6, 1913. Note the damage to the epiphyseal cartilage of the metacarpus.



FIG. 2.—Condition of hand showing the formation of a new thumb. July, 1913. Soft tissue has been grafted from abdomen.



FIG. 3.—X-ray of hand nine years later. Note that the metacarpus has developed greatly.



FIGS. 4 and 5.—Show result after nine years of functional use.

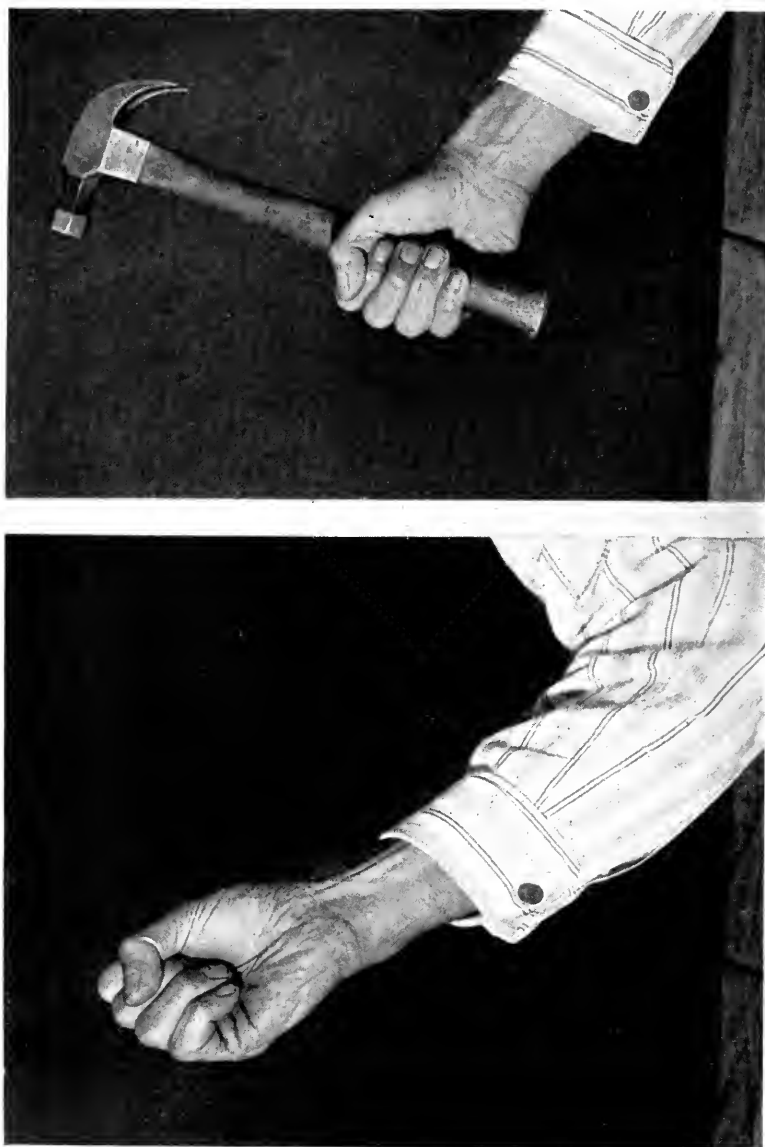




FIG. 6.—Condition of hand on admission. The fingers are fixed in the position shown.



FIG. 7.—Shows palmar aspect of cast cut away and the method of inserting the felt wedges between the back of the cast and the first phalanges. Complete flexion at the metacarpophalangeal joints has been obtained.



FIGS. 8 and 9.—Show the functional results obtained.

paper-like scar just above the wrist, into this pass the atrophied extensor tendons of the fingers. Over the radius there is a deep adherent longitudinal scar. Patient says this was the result of a drainage incision. The flexor tendons are intact. There are no nerve lesions present. The picture is that of a painful, stiff and useless hand.

The interest lies in the fact that this case presents some of the common sequelæ of injuries associated with infection. From the rich material that the war furnished us, surgery has been able to draw valuable conclusions regarding the immediate and after-treatment of wounds. It is our duty to apply these lessons to the injuries of civil life. An examination revealed the following conditions. There was partial ankylosis of the wrist, due to fibrous adhesions; the extensor tendons of the wrist were shortened and adherent to a mass of scar tissue. There was marked damage to the extensor tendons of thumb. Flexion at the metacarpo-phalangeal joints was impossible, due to the shortening of the extensor tendons and the fibrous thickening of the metacarpo-phalangeal capsules. To overcome these difficulties, the following course of treatment was outlined:

(1) The breaking up of as many as possible of the adhesions in the wrist, tendons and joint capsules. (2) The fixation of the wrist in dorsi-flexion. (3) The gradual flexion of metacarpo-phalangeal joints, with the corresponding stretching of the extensor tendons. (4) The tendons to be freed when the maximum amount of function has been obtained by conservative means. (5) The functional re-education of the hand.

On March 22, 1921, under ether. The wrist, finger joints, and tendons were mobilized as much as possible by manipulation, a moderate dorsi-flexion of the wrist with a slight flexion of the metacarpo-phalangeal joints was obtained. The hand and forearm was then put up in plaster. On the palmar side the case extended from above the elbow to the heads of the metacarpals on the dorsum from above the elbow, over wrist and fingers and back up on the palmar surface to the wrist. This enclosed the hand. When the case was sufficiently set, the portion of the palmar surface of the case in relation to the fingers was cut away. Wedges of piano felt were inserted between the dorsum of the distal portion of the metacarpals and the overlying beak of the case (Fig. 7). The leverage being applied so that the metacarpo-phalangeal joint surface would be separated and the capsule stretched. Additional wedges were added as required. The metacarpals were completely flexed in three weeks. As wedging was no longer necessary, the beak of the case was removed, and spring traction was made from above the elbow to a padded bar applied over the distal portion of the metacarpals. In this manner the same force was applied, but the additional advantage of massage and movements of terminal phalanges were obtained. The case was removed two weeks later, and spring traction was taken from a cuff on the arm to the padded bar over the metacarpals. By April 13th, the patient began to develop a light grasp. When the patient began to voluntarily flex the joints and could retain the flexion, the apparatus was removed during the day-time, but applied at night. Systematic

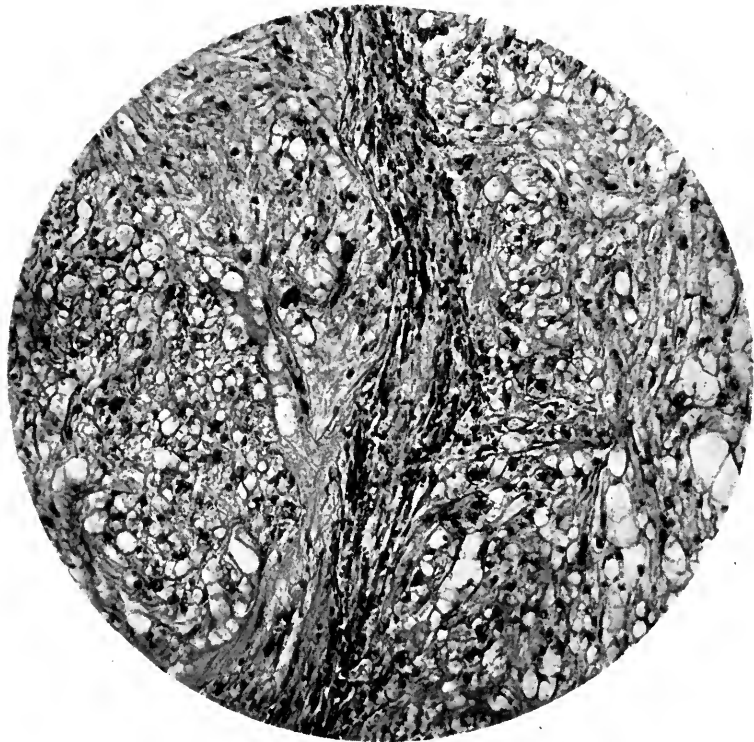


FIG. 10.—Chordoma (sacro-coccygeal).

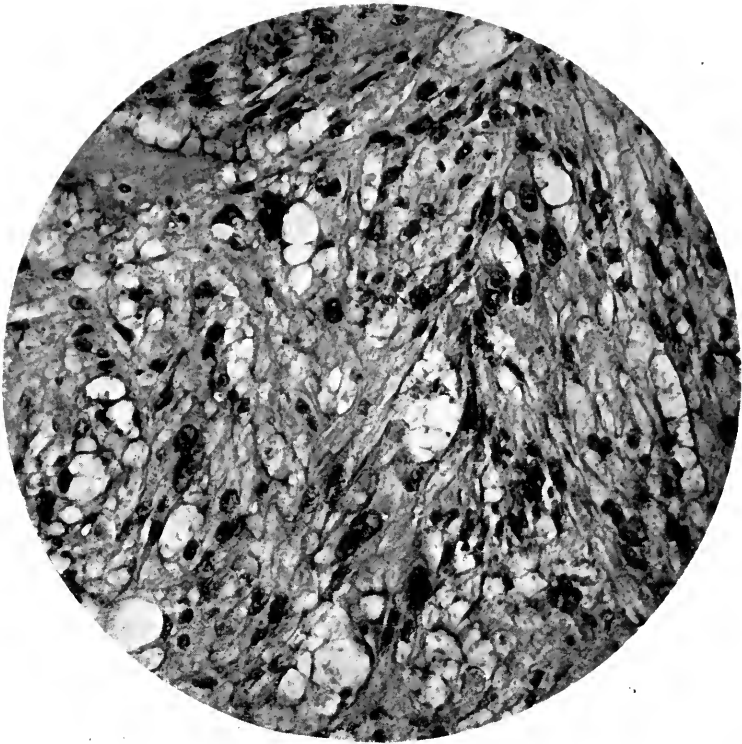


FIG. 11.—Chordoma (sacro-coccygeal).

exercises and occupational therapy were vigorously carried out. In June the tendons were freed from the skin and from the deeper parts. This resulted in a slight improvement. You will note that the patient can make the firmest kind of a fist, and can swing a heavy hammer. Figures 8 and 9 show the functional result obtained. The elaboration of this method of treatment is due to Dixon, of England.

## WHEELER SKIN-GRAFTING OPERATION APPLIED TO AN EXCISION OF AN EPITHELIOMA OF LOWER EYELID

DR. H. H. M. LYLE presented a man who was admitted to his service at the Skin and Cancer Hospital, with a moderate-sized basal-cell epithelioma of the lower lid. He first noticed it two years ago. Lately it has begun to grow more rapidly. The growth, with the skin of the lower eyelid, was excised, and the defect in the lower lid filled by a graft taken from the upper lid, and the eyelids sutured together. The method and technic was that originated by J. Wheeler, of New York. This patient was operated on thirty-seven days ago, and was shown in order that the society might observe the progress of the case. He will be shown again after the period of maximum contraction has passed. It will be noted that the defect in the upper eyelid is almost invisible, and the graft in the lower lid can hardly be distinguished from the surrounding tissue. For the details of the operation and after-care, the Society is referred to Wheeler's article, J. A. M. A., November, 1921, page 1628.

## SACRO-COCCYGEAL CHORDOMA

DR. EUGENE H. POOL presented a case of chordoma because the lesion is rare, yet one should ordinarily recognize the condition clinically. Chordoma arises from a remnant of the notochord and occurs usually at the base of the skull or in the sacro-coccygeal region. It is composed of peculiar vacuolated cells. N. D. C. Lewis has recently reported four cases (*Archives of Internal Medicine*, 1921, vol. xxviii, p. 434). F. B. Lund (*Boston Medical and Surgical Journal*, 1919, vol. clxxx, p. 708), and H. Albert (*Surgery, Gynecology and Obstetrics*, 1915, vol. xxi, p. 766), have also contributed cases.

The patient, a woman, sixty-five years old, was admitted to the New York Hospital, June, 1921; she had experienced steady increasingly intense pain in the sacral region for two years. Three months before she felt a mass per vagina. Menopause fifteen years ago and has had no bleeding since. No blood by rectum but was very constipated. Also had frequency and urgency of micturition, with nocturia four times. Past history negative. There was no weakness or loss of weight.

Examination showed fairly well-nourished woman. Thorax and abdomen negative. In the sacro-coccygeal region, palpated through the posterior wall of the rectum, was a hard, circumscribed, slightly nodular mass about three inches in diameter, broadly attached to the sacrum and giving an egg-shell crackle on surface.

As the pain had become unbearable palliative operation was decided

upon, the broad attachment and involvement of the sacrum making a radical operation impossible. Radium was not advised on account of danger to bladder and rectum.

Sagittal incision with removal of coccyx. The coccyx and sacrum were found to be infiltrated by a soft neoplasm extending upward and forward for three inches, forming a broken-down mass with rather dense walls, in which were fragments of the bone which had been separated from the sacrum. Rectum not involved. The growth evidently originated within the sacrum. It was removed as completely as possible. Wound packed and left partially open for radium therapy. Considerable hemorrhage resulted and six hours later she was transfused. The patient was transferred to General Memorial Hospital, fifteen days post-operative, where she received radium therapy. For some months patient was relieved of pain. Returned to New York Hospital March 2, 1922, with a recurrence of pain in sacral region and a rounded tumor about two and one-half inches in diameter palpable through posterior rectal wall, evidently a recurrence of the tumor in the original location. There is no evidence of metastases, although complete fluoroscopic examination has been made.

Apparently these sacro-coccygeal chordomas regularly occur in the hollow of the sacrum; according to Lewis they infrequently give rise to metastases but infiltrate widely and have proved 100 per cent. fatal.

*Pathological Report by Doctor Müller.*—Specimen consists of a mass of soft crumbly material five cm. in diameter, and a piece of bone (coccyx) to which a quantity of similar material is attached.

*Microscopical.*—(Figs. 10 and 11.) The cell outlines are very indistinct and the general picture is that of vacuolated syncytial tissue having a tendency to stain blue with hæmatoxylin. This blue stain suggests the presence of mucin. The nuclei vary much in size and shape, but most are large oval nuclei with abundant finely granular, closely packed chromatin material. In many nuclei a nucleolus is visible. Some nuclei are distinctly hyperchromatic. The vacuoles in the syncytium, which are perfectly clear, are very numerous, mostly round, and vary in size up to the size of an adult fat cell. A few small spicules of bone are present in some sections. Bands of connective tissue with round-cell infiltration divide the tissue up into pinhead-sized lobules.

#### PLASTIC OPERATION ON LEG

DR. EUGENE H. POOL presented a case which, although it might appear too trivial to present, seemed to involve a principle which might prove of some value for covering large defects over the flexor surfaces of elbow or knee. Especially in a child, a large pedunculated flap to cover such a defect is not only difficult to secure, but considerable additional scarring must result; Thiersch grafts in these positions are likely to result in contraction. The procedure employed in this case was to throw a bridge of healthy skin across the centre of the granulating area corresponding approximately to the flexure of the knee. The much reduced granulating areas above and below may be

## DUODENAL DIVERTICULA

covered with Thiersch's grafts, the transverse bridge of normal skin preventing contraction of the cicatrix.

The procedure as applied in this case was as follows:

The patient was a girl four years of age. As the result of an automobile accident there was a large infected wound with loss of superficial soft parts over the popliteal space. On admission there was a granulating area over the popliteal space six by four inches. Around the upper part of the wound and about one inch from its edge an incision was made so that a flap was raised attached at its ends on each side of the granulating area. It was lifted with the subcutaneous tissues and was readily swung downward across the flexure of the knee, where it was sutured with a few fine chromic stitches. The leg was put up in extension. The upper angle from which the upper part of the flap was removed was approximated by sutures. A small part of the middle of the graft sloughed, but the remaining parts of the flaps could be brought together with adhesive and formed a bridge across the denuded area. In another case Doctor Pool said he should simply bring over a flap from each side and fix them as a bridge with sutures and adhesive; also making the bridge conform more closely to the flexure of joint. Subsequently Thiersch grafts were placed upon the granulating areas above and below the cutaneous bridge. The result has been thoroughly satisfactory.

## DUODENAL DIVERTICULA

DR. WILLIAM A. DOWNES read a paper with the above title, for which see page 43.

DR. JOHN F. ERDMANN said he had had two of these cases, one four years ago and one five years ago. Both were diagnosed as diverticulum cases by X-ray and both were operated upon. In neither one of the two was there a chain of symptoms expressive of anything clear. It could not be said they were improved by operation. The first was on the inner, *i.e.*, pancreatic, aspect of the first portion of the duodenum and about the size of a large prune. That of the second patient was on the antero-internal aspect of the first portion of the duodenum and almost twice the size of the first. They were both in females, one about fifty and the other about fifty-five years of age. No difficulty was present in any stage of the operation and both made early and satisfactory recovery.

DR. EDWARD W. PETERSON said that he had operated upon one case of duodenal diverticulum. The patient, a man of about sixty years, was sent to him by Doctor Page, of White Plains. A preliminary diagnosis of carcinoma of stomach was made, but Doctor Myers, of the Post-graduate X-ray Department, found no evidence of a new growth or of ulceration in the stomach or intestinal tract. There was present, however, a diverticulum of the second portion of the duodenum. At operation the diverticulum was located and removed without any difficulty. The patient also had a gall-bladder filled with stones, for which a cholecystectomy was done. This latter



FIG. 12.—Granulating wound of popliteal space.



FIG. 13.—Flap from each side across flexure of knee (healed in place).





FIG. 14.—Final result showing transverse bridge of normal skin. Areas above and below covered with Thiersch grafts.



FIG. 15.—Final results.

condition probably accounted for the marked digestive disturbances, which had suggested malignancy. The man had lost his wife but a short time before and was decidedly melancholic. He expressed a wish to die. He was discharged from the hospital, but did not improve, and about three months later was admitted to the medical service of the hospital. In spite of the most careful and thorough study no pathological condition was ever diagnosticated. He progressively grew worse and finally died, with the cause of death never satisfactorily explained.

DOCTOR DOWNES said that in the great majority of these cases the diverticulum was an accidental finding without symptoms and did not require operation. In the two cases he operated upon there was nothing else to account for the periodic attacks of diarrhoea and for the acute dilatation of the stomach. He considered that operation had been the proper procedure in these cases for they were both relieved as a consequence.

#### CHRONIC ARTHRITIS OF KNEE-JOINT, GONOCOCCUS BACTERIÆMIA, SUBACUTE GONOCOCCUS ENDOCARDITIS, INFARCT OF SPLEEN

DR. RANSOM S. HOOKER presented a girl sixteen years old, who was admitted to the First Surgical Division, Bellevue Hospital, November 28, 1921, with a swollen and painful knee, of fifteen days' duration. She had always been well except between the ages of eight and twelve, when she had pain over heart and difficulty in breathing. At present she has no precordial pain, cedema, or dyspnoea.

Physical examination of heart shows mitral stenosis and insufficiency with cardiac hypertrophy and dilatation.

Patient's temperature on admission was  $101^{\circ}$ , pulse 104, respiration twenty. Urine normal except for faint trace of albumen. Leucocytes 11,200, polymorphonuclears eighty-two per cent.

X-ray shows "moderate effusion into the left knee-joint and suprapatellar bursa. The joint space is of moderate width. There is a small area of necrosis on the articular surface of the inner condyle of the tibia."

Vaginal examination showed the uterus and adnexa apparently normal. Slight discharge from cervix. Cultures and slides from cervix and vagina, negative for gonococcus.

During the following seventy-seven days patient's temperature fluctuated daily about two degrees on the average, running between  $100^{\circ}$  and  $104^{\circ}$ . Repeated blood cultures were taken which showed no growth until, on the sixty-third day, gonococci were found.

No operation was performed on the knee, as this condition did not seem to be progressive and was thought to be peri-articular. The knee was immobilized, followed by cessation of pain shortly after admission. It was believed that the patient had a bacterial endocarditis. At no time were gonococci found in cervix or vagina.

On her seventy-third day she died and autopsy findings were as follows:

Chronic productive mitral and aortic valvulitis. Acute vegetative

## CHRONIC ARTHRITIS OF KNEE-JOINT

mitral valvulitis. Acute verrucous aortic valvulitis. Slight hypertrophy and dilatation of heart. Œdema of lungs. Bilateral hydrothorax. Chronic passive congestion of liver. Chronic septic splenitis. Infarcts of spleen with localized perisplenitis. Localized acute fibrino-purulent peritonitis (in the cul-de-sac of Douglas). Chronic gonococcus? arthritis (left knee-joint). Cervical erosions. Ascites.

Post-mortem, microscopic findings: Chronic passive congestion of lungs. Subacute suppurative peritonitis with granulation tissue. Infarct of spleen. Acute glomerular nephritis. At post-mortem bacteriological examination of heart valve, gonococci were found. Staphylococcus aureus from the spleen.

## BOOK REVIEW

**SURGICAL DIAGNOSIS AND TREATMENT.** By American Authors. Edited by ALBERT J. OCHSNER, M.D., LL.D. 4 vols, octavo cloth, pp. 850, 861, 1018 and 972. Lea and Febiger, Philadelphia.

These four great volumes again illustrate the activity, earnestness and progressiveness of the American surgeons of to-day. Assembled by the distinguished editor seventy-three of his colleagues have joined with him to produce this work, which is intended to give the last word in the field of surgical diagnosis and treatment.

As we read the list of contributors, we are struck with the large number of them who are Fellows of the American Surgical Association, which means that they are men who have long been recognized as leaders among American surgeons. This means also that they speak with authority, and that the reader is consulting the work of one who has both judgment and experience. As showing the uncertainty of life and the transitoriness of position once attained, one is pained to find in this list the names of at least three surgeons who had died before their contribution was published. These are McKenzie, of Portland, Oregon; Ransohoff, of Cincinnati, and Rodman, of Philadelphia. The chapters left by these men in these works will be treasured as their final contributions to the science, which each of them had done so much to enrich.

The editor in the preface of the first volume dwells on the fact that the professional careers of the present leaders in surgery represent a period of advance in methods of diagnosis and treatment unequalled by the progress of many previous centuries. He goes on to say that this particular work is intended to reflect in every sense the current practice and thought of the most intensely active surgeons of this continent. As each succeeding volume has made its appearance, it has been apparent that its contents continue to fairly justify the original expectations of the editor, and the sum total is most helpful and satisfactory to the eager surgeon who resorts to it for counsel. The series of volumes begins with a chapter on Surgical Prognosis. The last chapter of the last volume is devoted to a discussion of the problems involved in the construction of a surgical hospital. In the intervening chapters from start to finish are found discussions by master surgeons of every possible question of diagnosis and treatment presented in the surgery of the twentieth century.

LEWIS S. PILCHER.

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## PLASTIC SURGERY OF THE FACE

By EMMETT DE WITT HIGHSMITH, M.D.

OF ATLANTA, GEORGIA

PLASTIC surgery is concerned with any portion of the body in which there are defects from any cause, or from errors of development, though only deformities of the face will be discussed in this paper.

The chief aim of this work is to restore function, as well as to correct deformities. The technic differs to some extent from general surgery, especially operations on the face. As it is very necessary to prevent scar tissue as much as possible, we must be careful not to traumatize delicate tissue, lest our carelessness be registered in a deforming cicatrix.

Possibly the most frequent facial deformity we are called on to correct is harelip and cleft-palate, and while this condition is not a menace to life, these unfortunate individuals are greatly incapacitated, and as this deformity is relatively rare, too often they are allowed to go through life without correction or encouragement. The general surgeon only sees a few cases in a lifetime, though I think there is a greater number than is generally supposed.

Davis claims that harelip occurs once in 2400 infants; that there are 73 per cent. more males than females; and that more often a left side involvement than right.

Harelip operations should be done early. If there is a separation of the gums it is of the utmost importance that these cases be operated on before the fourth month, in order that the alveolar process may be bent and held in apposition by metal splits.

Lip operations can be done well at any age. In order to overcome the stiffening effect of the scar, whether the patient be infant or adult, it is essential to exercise the lip through massage, and in the case of an infant the use of the pacifier is beneficial for this purpose.

The cleft-palate cases should be done before the child learns to talk, as it is very hard to break them of their nasal sounds, once they have been established.

Rhinoplastic operations are even more rare than lip operations, though often the deformity is much more unsightly. While these patients do not suffer real pain, their humiliation is great and many are robbed of the chance to earn a livelihood by their unsightly appearance. The great value of these operations is the cosmetic and psychic effect.

In the reconstruction of a nose there are three essential factors to be considered:

- 1st. An epithelial lining.
- 2nd. A bone or cartilage framework.
- 3rd. A skin covering.

The epithelial lining can be obtained from the adjacent skin with a pedicle.



FIG. 1.—Case I. Front view showing destruction of nose and lip; before operation.



FIG. 2.—Case I. Profile.

If bone is to be used for the bridge it can be taken from the outer table of the frontal bone of the forehead attached to the flap to be used for the skin covering.



FIG. 3.—Case I. Showing patient ten days after first operation with Wolf graft in place on forehead, and before pedicle of nose is cut and returned.



FIG. 4.—Case I. Showing patient six months after the nose and lip operation has been completed.

I prefer cartilage to bone, which can be easily obtained from the ninth costal cartilage. In this case it is best to cut the cartilage to the size and shape desired, leaving on all the perichondrium possible, embed this in centre of the flap to be used from the forehead ten days prior to the operation in

## PLASTIC SURGERY OF THE FACE

order that the circulation may be thoroughly established before the flap is disturbed.

CASE I (Fig. 1).—A young woman age thirty-one. Had always enjoyed good health until eighteen years of age, when a hard, indurated ulcer appeared on the upper lip which remained for six months with very little change. After that time it began to spread very rapidly, destroying the upper lip and nose to the



FIG. 5.—Case II. A young man twenty-four years old with a congenital deformity of the nose and lip. Family and past history negative.



FIG. 6.—Case II. Three months after operation.

nasal bones. Up to this time no diagnosis had been made; a later consultant was supposed to have given her some "blood medicine" and the ulceration rapidly healed. She came to the Gray Clinic in Atlanta in 1920, examination



FIG. 7.—Case III. Shows baby three months old with unilateral harelip with wide cleft through alveolar process extending through horizontal process of palate with deviation of nasal septum to the right.



FIG. 8.—Case III. Eight weeks after first operation and two weeks after second operation.

showed a 4-plus Wassermann. She had taken thirty-two doses of Diarsenol with a 3-plus Wassermann when the first operation on her nose was done. Three months after the operation was completed she had a 4-plus Wassermann.

*Technic of Operation.*—Ten days prior to the nose operation the rudimentary

septum was cut above, leaving a pedicle below, and brought down to act as a part of the supporting framework and the septum of the new nose. Also a piece of cartilage about one and a quarter inches long was taken from the ninth costal cartilage and cut to the size and shape desired, and slipped under the skin of the forehead in the centre of the flap to be used for the skin covering of the nose. At the time of the nose operation the patient was given 4-½ ounces of ether in olive oil, colonic method, which completely anesthetized her for a period of two hours. A cross incision was made through the skin on the nose and equal distance above to the prepared septum below, and turned down, leaving epithelial side down for the skin lining, and sutured to the prepared septum. A triangular piece of skin on each side of the nose was turned up and sutured to the first flap and septum, completing the epithelial lining. Then by actual measurement with a piece of tin foil, the skin covering for the nose was cut from the forehead with pedicle attached, leaving the prepared cartilage in the centre, sutured and dressed with Carpenter's court plaster.

CASE II (Fig. 5).—A young man, twenty-four years old, with a congenital deformity of the nose and lip. Family and past history negative.

*Technic of Operation.*—A horizontal incision through upper lip just above vermilion border and closed with dermal suture, bringing the thin tab down which gives the appearance of the cupid's bow, and dressed with Carpenter's court plaster which was left on five days.

In correcting the nose, a vertical incision was made commencing in the centre over nasal bones and extending to near the tip of nose. A portion of nasal bones was chiseled off, the cartilage on right was removed and the cartilage on left swung to the centre for the supporting framework of the nose. The redundant skin was cut away, and dressed with Carpenter's court plaster.



## HARELIP AND CLEFT-PALATE DEFORMITIES, SOME OF THE TYPES AND THEIR OPERATIVE TREATMENT\*

By WARREN B. DAVIS, M.D.

OF PHILADELPHIA, PA.

THROUGH the kindly interest of my chief (Dr. J. Chalmers DaCosta) in my work in maxillo-facial surgery, it has been my good fortune to have the privilege of operating upon all harelip and cleft-palate cases admitted to "Surgical Division A" at the Jefferson Hospital since 1915. Our endeavor has been to make the most of this opportunity by familiarizing ourselves with the numerous operations which have been devised for the correction of the varying degrees of these congenital defects, selecting such operative measures as seemed most practical and applying them to those cases which seemed best suited to a particular type of operation. Thus we have no "new operation" to describe, but we have assembled a composite technic which is giving gratifying results in a large majority of cases—both from the functional and the cosmetic viewpoints.

We will illustrate by individual cases a few of the types of deformity, describe briefly the essential points in the methods we have found most efficacious in dealing with each type, showing photographic records of the results obtained.

*Unilateral Harelip.*—Single, simple harelip deformities (Figs. 1 † and 5), complete or incomplete, usually require the same general plan of treatment, since in the majority of cases in which the cleft extends as far as half-way through the lip, there is little or no muscle tissue between the upper angle of the cleft and the floor of the nostril. To correct this condition it is necessary to convert such incomplete clefts into complete ones in order to secure approximation of the muscles and to properly correct the flattening of the ala nasi and the accompanying widening of the nostril.

In outlining incisions for the correction of harelip, the method devised by J. E. Thompson has, in our cases, been by far the most satisfactory—both at the time of operation and in the end results. With sharp-pointed calipers the distance is measured from the mid-point of the floor of the nostril to approximately the point in the same sagittal plane to which the free margin of the lip would come if it were of normal contour. Fixing the distance on the calipers and keeping the superior point at the mid-point of the floor of the nostril, the inferior point of calipers is rotated, describing an arc which crosses the vermilion border of the lip on each side of the cleft (Fig. 2). The points where the vermilion borders are crossed by the arc are distinctly

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\* Read before the Philadelphia Academy of Surgery, February 6, 1922.

† Figures 1-4, 7-10 and 12 are from the author's article in the *Surgical Clinics of North America*, February, 1922, and are used here by the courtesy of the W. B. Saunders Co.

marked by making a puncture with the point of the calipers or with a small scalpel. Points on the free margin of the lip are then located so that lines connecting the three points on each side of the cleft (the mid-point of the floor of the nostril, the point marked at vermilion border, and the point now being located on free margin) will form an angle of approximately seventy



FIG. 1.—Case I. J.M. Age twelve months. Unilateral harelip. Note moderate flattening of the ala nasi and consequent widening of nostril.

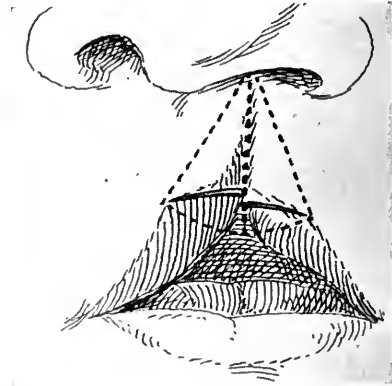


FIG. 2.—Semi-diagrammatic sketch, showing application of Thompson method of determining points for lines of incision for correction of harelip, as used in Case I. (See description in text.)

to eighty degrees—the angle being equal on the two sides. Incisions carried through the entire thickness of the lip with a narrow scalpel at a right angle to the skin surface and following along the lines as outlined, will give



FIG. 3.—Case I, four hours after operation. Note position of sutures, and the fulness at point of approximation on free margin of lip.



FIG. 4.—Case I, showing contour of lip and nostril, six and one-half months after operation.

surfaces for approximation which are of equal length and which when sutured together will give a lip the length of which is the estimated normal length plus the distance from the vermilion border to the free edge, which is usually just sufficient to allow for subsequent contraction. Before approximating the margins it is essential to free the supero-lateral portions of the lip from the

## HARELIP AND CLEFT-PALATE DEFORMITIES

anterior surfaces of the maxillæ through incisions made above the alveolar process. This relieves tension and allows the ala nasi to be brought into approximately normal contour. Figure 3 shows Case I four hours after operation. Figure 4, six and one-half months later.



FIG. 5.—Case II. H. S. Age five months. A less extensive unilateral harelip, showing scantiness of muscle tissue in upper portion of lip between the angle of the cleft and the floor of the nostril, with the consequent flattening of the ala nasi.



FIG. 6.—Case II, showing contour of the lip and the improved position of the ala nasi, eleven weeks after operation.

Case II shows a much less extensive harelip (Fig. 5), yet the nostril is distinctly flattened and widened. By carrying the incisions into the floor of the nostril, securing muscle approximation and bringing the ala of the

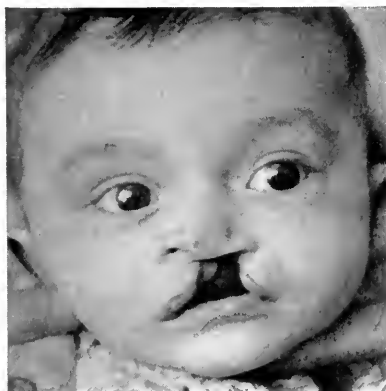


FIG. 7.—Case III. H. E. F. Age five months. Complete unilateral harelip and cleft palate.



FIG. 8.—Sketched from an operation on a child three months old, showing partial division of alveolar process, posterior to canine area on right side, to facilitate bringing the premaxilla into normal position, closing the cleft in the alveolar process on left side. A silver wire suture holds the parts in apposition.

nostril into proper position, a normally functioning lip and a greatly improved nostril were obtained with but slight increase in the linear scar (Fig. 6).

*Complete Single Harelip and Cleft-Palate* (Fig. 7).—This type shows wider separation of the lip margins, marked flattening of the ala nasi, deflection of the nasal septum to the opposite side and varying degrees of antero-superior rotation of the margin of the premaxilla. The surgical treatment is preferably by a two-stage operation—both operations being completed before the child is two years old. We believe best results are obtained by closing the cleft in the alveolar process and repairing the harelip at the first operation, which should be done as soon as the child is in good condition, and it is known that the formula used in feeding is a suitable one. We usually select a time somewhere between the tenth day and the third month. The repair of the remaining cleft of the palate is preferably done sometime



FIG. 9.—Case III. Twenty-two months after first operation, showing union in alveolar process and the position of teeth.



FIG. 10.—Case III. January 15, 1922, twenty-five months after first operation, showing contour of lips and nostril.

between the twelfth and twentieth months. By such a schedule the deformity is less and the articulate speech better than in cases operated upon at later periods.

A wide alveolar cleft is repaired by partially dividing, with a thin chisel, the buccal side of the alveolar process just posterior to the canine region, on the side opposite the cleft, and then by combined digital pressure on the antero-superior portion of the premaxilla, and intra-nasal pressure against the lower portion of the nasal septum and the nasal floor with a small Sinexon nasal dilator, the alveolar margins are forced together. (Narrow clefts may sometimes be approximated in infants without the preliminary partial division of the alveolus.) The margins of the cleft must have the mucous membrane removed so that raw surfaces can be brought into contact. A green-stick fracture occurs at the point of partial division of the alveolar process, the degree of fracture depending upon the width of the cleft to be closed. The margins are held in approximation by a silver wire applied as shown in Fig. 8.

This procedure not only closes the alveolar cleft, but by bringing the premaxilla to its normal position, the deviation of the nasal septum is corrected

## HARELIP AND CLEFT-PALATE DEFORMITIES

and the width of the cleft in the lip greatly decreased. The lip is then repaired in essentially the same manner as described above, but requires greater separation of the lip from the anterior portion of the maxillæ, and greater care in bringing the base of the ala nasi sufficiently medial by the first suture applied at the floor of the nostril. Figure 9 shows Case III, twenty-two months after operation. There is complete union of the alveolar process and the prospects are that but little orthodontic work will be required later, presuming that the permanent teeth will be in as good position as the deciduous.

The closure of the remaining cleft in the palate we prefer to do by the Langenbeck muco-periosteal flap-sliding method. If the width of the cleft



FIG. 11.—Case IV. E. McG. Age four weeks. Double harelip and cleft palate, incomplete on left side.

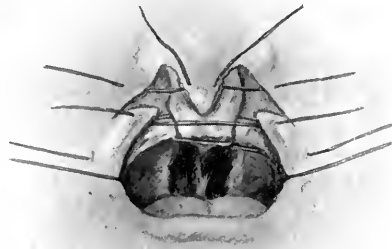


FIG. 12.—Sketch from an operation on a three months old child with double harelip and cleft palate, showing premaxilla held in position by silver wire suture through alveolar processes, and the incisions made for repair of lip defects. (The sutures shown through the entire thickness of the infero-lateral portions of lip are temporary traction sutures which assist greatly in handling the lip, producing less trauma than does the use of forceps.)

is sufficient to make additional width of flap necessary, the muco-periosteal flap dissection can be carried around the lower margin of the vomer on the attached side and one-fifth to one-fourth inch of mucosa taken from the lower portion of the nasal septum. These procedures were used in Case III, in which the second operation was at twenty-seven months of age. The separation of the muco-periosteal palate flaps from the nasal mucosa at the posterior margin of the palate bones is important to secure sufficient relaxation at that point. Moorehead, *Journal A.M.A.*, December 17, 1921, regards this step as the most common cause of non-union, but it has not proven so in our cases. We prefer to approximate the margins of the flaps with interrupted sutures of 00 wire, from the anterior point of cleft to the junction of hard and soft palate, at which point one on-end silk mattress suture is used. Posterior to this point interrupted black silk sutures are used. Small iodoform gauze packs in the lateral incisions aid in relieving tension.

Packs are removed in forty-eight hours. If the horizontal process of the maxillæ and the palate bones are not sufficiently developed to hold such a pack safely, then an iodoform gauze tape is passed around both flaps (Mayo method) and tied or sutured at proper tension—using care that circulation in the flaps is not restricted.

Post-operative treatment: In infants, water only is given by mouth during first six or eight hours, then gradually resume formula used previous to operation. In older children, an abundance of water only is given by mouth during the first twenty-four hours. Salt solution containing soda bicarbonate is given by bowel at three-hour intervals during the first twenty-four hours. Small doses of deodorized tincture of opium are given if needed to allay



FIG. 13.—Case IV, nine days after operation, shortly after sutures were removed.



FIG. 14.—Case IV, two months after operation. Note contour of nostrils.

excessive crying. A few drops of fifteen per cent. argyrol solution are placed in the nasal passages with a dropper every three hours. No intra-oral applications are made routinely in infants.

In older children and in adults, a normal salt solution mouth wash is used at three-hour intervals, followed by argyrol application along suture line and in lateral incisions. In these older cases, liquid nourishment is continued for eight days, then semi-solid diet is allowed. Solid food is not given for sixteen days. Figure 10 shows Case III, January 15, 1922, twenty-five months after first operation. The articulate speech is good and shows the advantage of complete early closure of clefts.

*Bilateral Harelip and Cleft-Palate.*—Case IV illustrates bilateral harelip with wide separation of margins, and double cleft palate, complete on right side, but not extending through alveolar process on left side (Fig. 11).

When the child was four weeks old, the cleft in the alveolar process was repaired as described in Case III. Measurements for lip margins were by the Thompson method. The philtrum was trimmed to a "V" shape just within the vermillion borders. Incisions were similar to those shown in Fig. 12. The wide separations of the margins necessitated more extensive

## HARELIP AND CLEFT-PALATE DEFORMITIES

freeing of the lip from the anterior surfaces of the maxillæ to allow approximation without undue tension, and to bring the alæ of nostrils into approximately normal position. To avoid tension on suture lines, a stay-suture of silkworm gut was passed far lateral on each side, and held at desired



FIG. 15.—Case V. L. P. Age seventeen years. Opening in hard palate persisting after an operation for double cleft palate, which was done when patient was one year old.



FIG. 16.—Case V, showing good union of soft palate and the opening in hard palate.

tension by perforated shot over a button resting on adhesive plaster (one-half inch by three-quarter inch) to give increased surface traction and prevent much cutting of skin by the suture (G. V. I. Brown method). Figure 13

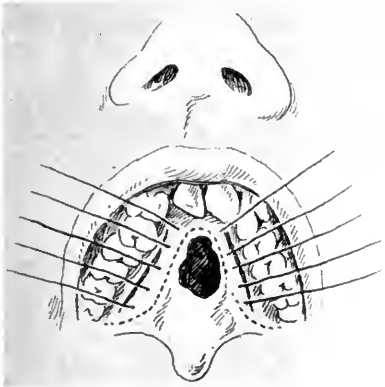


FIG. 17.—Semi-diagrammatic sketch of Case V. Dotted line indicates margins of bony cleft. Lateral incisions are shown, through which the bones were divided.

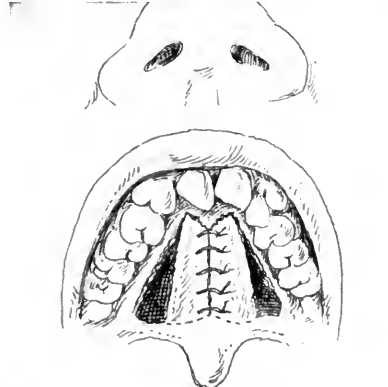


FIG. 18.—Semi-diagrammatic sketch of Case V, showing approximation of the margins of the opening in the hard palate. The site of the green-stick fracture produced anteriorly is indicated, as are also the posterior ends of the bones in their new position.

shows condition of Case IV, nine days after operation, shortly after the sutures were removed. Figure 14 is Case IV two months after operation. We have advised closure of the remaining cleft in the palate when the child is twelve months old. So wide a cleft may necessitate a two-stage operation,

the first loosening the muco-periosteal flaps through Langenbeck incisions, making the separation to, but not through, the medial margins, then making partial approximation by packs for several days, after which the margins of the cleft will be removed and definite approximation of flap edges made.

*Incomplete Union in Hard Palate.*—Repair of a defect in the hard palate which had persisted after an operation in early childhood for double cleft palate. Often a secondary repair is more difficult than a primary operation, because of scar tissue, poorer circulation and less tissue for flap formation. Such openings in the hard palate are tedious to close, especially if located far anterior. Case V shows an opening in the hard palate of a girl seventeen years old (Figs. 15 and 16). The primary operation was done by another surgeon when the patient was one year old.



FIG. 19.—Case V. Photograph of palate two months after operation.



FIG. 20.—Case V. Photograph of posterior portion of palate, two months after operation.

We believed that such an opening could be closed by any one of three methods. (1) By making lateral incisions, just within the alveolar process on each side, loosening muco-periosteal flaps and approximating them in midline, as in the Langenbeck operation. (2) By turning a muco-periosteal flap from the right side (the side in this case having the best blood supply), keeping its attachment at the margin of the opening, and carrying the turned loosened flap beneath a double-pedicle flap on the opposite side, suturing it in position, after the Lane method. (3) By bringing part of the horizontal processes of the maxillæ and palate bones medially with the attached soft tissues.

We have usually employed the first method in closing such openings, except when the opening is just posterior to the premaxilla, in which case the second method is preferable—unless the opening be a very small and narrow one. In the case illustrated here, however, the extent and position of the horizontal processes of the maxillæ and palate bones were such that we elected to try the third method, following essentially the plan devised by Ferguson, advocated



for many years by J. Ewing Mears, and later revived, improved and so successfully used by W. J. Roe in his primary cleft palate operations.

The mucous membrane was removed from the margins of the opening, carrying the incisions a short distance both anterior and posterior beyond the margins of the opening, in order to make its outline elliptical. Lateral incisions were made as shown in Fig. 17, and the muco-periosteum separated from the underlying bone for a distance of about one-eighth inch along the lines of incision. The horizontal processes of the maxillæ and palate bones were then cut through along these lines with a thin chisel and the overlying nasal mucosa also divided. The lateral incisions were extended posteriorly to the anterior portion of the soft palate. The strips of bone and the attached soft tissues were then forced medially, producing a green-stick fracture at



FIG. 21.—Case VI. C. B. Age 20. Showing deformity persisting after an operation for bilateral harelip, when patient was eight months old.



FIG. 22.—Case VI, showing contour of lip after secondary repair.

the anterior attachments of the bones, when the medial margins were approximated. Small holes were made in the partially detached bones and the soft tissue covering them, through which interrupted oo wire sutures were passed and tightened sufficiently to hold the medial margins in apposition (Fig. 18). One advantage of this method for this case was that the palate was slightly lengthened—a point of much value, especially in an adult case.

The lateral openings were packed with iodoform gauze. The packing was changed every forty-eight hours for eight days, after which the lateral openings closed by granulation. The sutures were removed on the sixteenth day. Union was complete. Figures 19 and 20 show the condition of the palate two months after operation. The patient is receiving special training for the correction of her speech defect, and already shows wonderful improvement.

*Secondary Repair of Harelip.*—Case VI (Fig. 21) shows a case twenty years old, who was operated upon when eight months old for correction of complete double harelip. (There was no cleft in alveolar process or palate.)

The result, as regards the floor and the alæ of the nostrils, was good, but the protruding philtrum and the median notch in the lip were decidedly disfiguring. Correction of the deformity required incisions to again convert it into a complete double harelip. Points for determining the lines of incision were located by modifying the Thompson method, taking as a starting point here the mid-point of the junction between the philtrum and the columella (instead of the usual mid-point of the floor of the nostrils). The distance was taken with the calipers from this location to the point where the free edge of the lip should normally be in the lid-line. With this fixed radius, an arc was described and the points marked where the arc crossed the vermilion borders. Incisions were carried through the entire thickness of the lip from the apex of the notch in the free margin of the centre of the lip to the apex of the philtrum, then laterally to the marked point immediately above the vermilion border and thence to the sides of the base of the philtrum. Corresponding incisions were made on the opposite side. The philtrum was then trimmed to a "V" shape. The tissue taken away by these incisions removed practically all the old scar tissue. The margins were then approximated as in closing an original double harelip, but using special care to bring the skin margins of the philtrum and the lip to the same level. Most of the sutures were placed in the muscle tissue and on the mucous membrane surface. A few fine interrupted silk sutures, alternating with horse-hair, were used on the skin surface. All skin sutures were removed by the fifth day. No dressings were applied at any time. The external and the internal surfaces of the lip were simply cleansed three times a day with boric acid solution, the skin surface dried and aristol powder lightly applied over the suture line. After the sutures were removed, sterile vaseline was applied over the area each night for a month. The very small amount of scar tissue which resulted and the contour of the lip after operation are shown in Fig. 22.

## OPERATIVE TREATMENT OF COMPLETE DOUBLE HARELIP

BY VICTOR VEAU, M.D.

OF PARIS, FRANCE

SURGEON OF THE FOUNDLING HOSPITAL

IN the article by James E. Thompson in the *ANNALS OF SURGERY* of October, 1921, are given some very good photographs for which he is to be thanked, because such documents are rare on this subject. These photographs, however, show that his technic is open to the same reproaches as we have already addressed to the French surgeons. I thank the Editor of the *ANNALS* for accepting the following remarks. They are the summary of a more extended work written in collaboration with my pupil Lascombe and published in the *Journal de Chirurgie* of February, 1922.

Since the year 1906, I have seen in the Foundling Hospital thirty-five cases of complete double harelip which have either been operated upon for the first time or retouched.

Thompson rightly condemns the excision of



FIG. 1.—Young girl fourteen years of age, who has undergone the extirpation of the premaxilla when ten months old.

the premaxilla. The photograph (Fig. 1) shows the bad results obtained by this method. But when the premaxilla is preserved, a sufficient projection must be given to the upper lip. It is to avoid this ugly profile that I have devised the following process, which is not original, for in it are combined different technics.

I always begin by operating upon the lip. The palate is only sewn later on. I have always closed the lip by two operations: 1st, by the pulling back

of the premaxilla; 2nd, definitive suture of the soft parts. This method is much less dangerous and gives better æsthetical results than that which consists in making only one operation.

*Age.*—I pull back the premaxilla at the age of two or three months. I sew the lip one month or two later. The palate will be closed during the second year. It is very important that the children should be operated only when they are in good health. The temperature must be taken during several

days. The skin must be very healthy. The nose must not run.

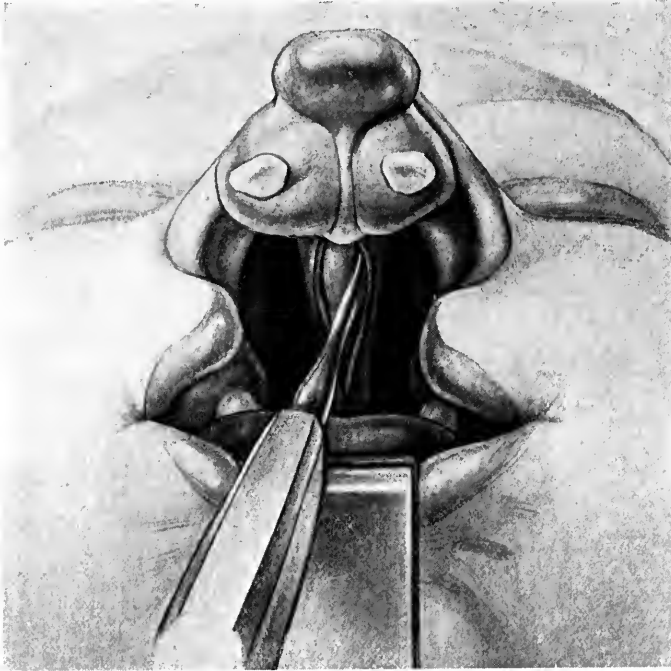


FIG. 2.—Loosening up the periosteum of the septum nasi after incising the mucosa.

pulling back is the septum. It would be rational to make a section, or better still, a triangular resection (Blandin, Mirault) of the septum. But the projection of the nose depends upon the integrity of the septum, any resection of this bone will flatten the nose in a very ugly manner. The neck of the bone must be cut horizontally. The columella will be naturally reconstituted.

*Technic.*—A. *The incision of the mucosa of the periosteum of the lower edge of the septum.* It is two centimetres long, it reaches the posterior side of the premaxilla. The hemorrhage is insignificant (Fig. 2).

B. *The elevation of the periosteum.* This part of the operation would be easy because the periosteum does not adhere to the bone, but the lower edge of the septum is very much enlarged, the prominence must be turned away from it. This loosening must above all be done in front towards the columella.

The section of the neck of the bone (Fig. 4) must be very carefully done,

*First Operation.*—The pulling back of the premaxilla. The premaxilla must never be taken away. The bone and the soft parts are indispensable to the reconstruction of the lip. In pulling back the premaxilla (Fig. 3), the surgeon must pay attention not to flatten the nose. The obstacle to the

a sharp pair of forceps are employed, a piece of bone must often be taken away in order to see more clearly what is being done. It is very important to pull back the premaxilla in a lump as a drawer is closed and not to turn it round an upper horizontal axis like a door that is shut. The incisor teeth must remain quite vertical and not oblique behind, a common mistake, nor horizontal as we have seen.

As to the incision made on the lower edge of the septum it is not necessary to sew it, it will close very quickly alone.

C. *The fixing of the drawn-back premaxilla.* A perforator is introduced as it is represented in Fig. 5, then it is raised and pushed back (Fig. 6). It brings back with it a double silver thread. After the section of the loop there is a double right thread and a double left thread.

For fear lest the tightening of the silver thread should cause necrosis of the anterior mucosa of the premaxilla, I am accustomed to bring back each anterior thread on the lateral parts following the manner indicated in Fig. 7.

The external point of support must be found on the maxillary process, the perforator is introduced

at five or eight millimetres from the anterior end of the point of the bone, it crosses it and brings back the posterior thread of the corresponding one. When the threads are knotted the premaxilla is fixed (Fig. 8).

If the premaxilla has a larger width than the space between the maxillary processes, the teeth of the premaxilla must be taken away. If, on the contrary, the premaxilla is much smaller, it must be carried into contact with one of the edges.

To facilitate the fusion of the bones it is well to lay bare the contiguous surface by taking away a piece of the mucosa, as it is represented in Fig. 8, but one must not count too much upon this fusion. I have only observed it once.

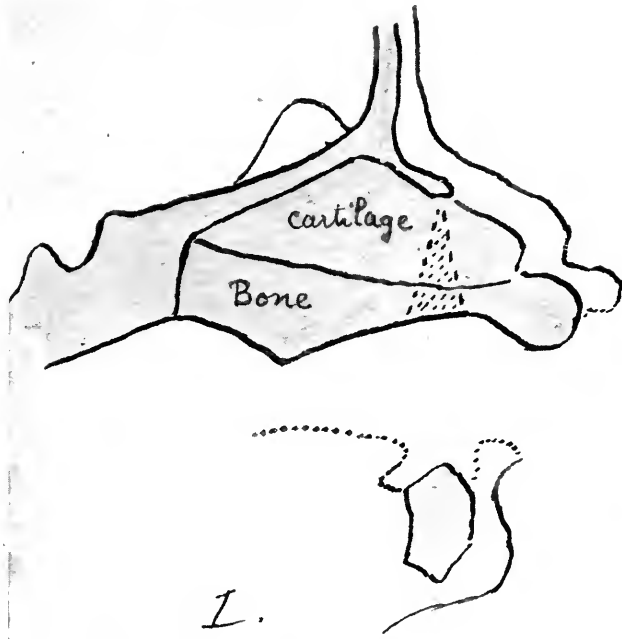


FIG. 3.—(1) Septum of a child three months old having a complete double harelip.

D. *The bringing together of the lip.* We do not try to make a completely restored lip, our only object is to create a bond of the soft parts in front of the drawn back premaxilla. I think that this means of fixing the premaxilla is much more important than the deep ligature by the silver thread.

The two mucocutaneous edges are refreshed as represented in Fig. 9. The skin is sutured. My custom is to place a vertical silver thread which takes the whole of the lip (Fig. 10) and which is knotted to the lower part. This thread generally cuts the mucosa, but that is of no importance, because the scars of the mucosa are never apparent.

*Care After the Operation.*—It is most important to prevent the child from

touching the operated part. This is easily done by introducing between the upper limbs of the child and his night-gown a cardboard roll which goes from the shoulder to the wrist and prevents the movement of the elbow; this cardboard must be fixed with a safety-pin to the night-gown to prevent its coming down.

*Second Operation.*

—Restoration of the lip. The qualities of a well-restored lip: (1) The cutaneous part must be supple; no piece of mucous membrane must be en-

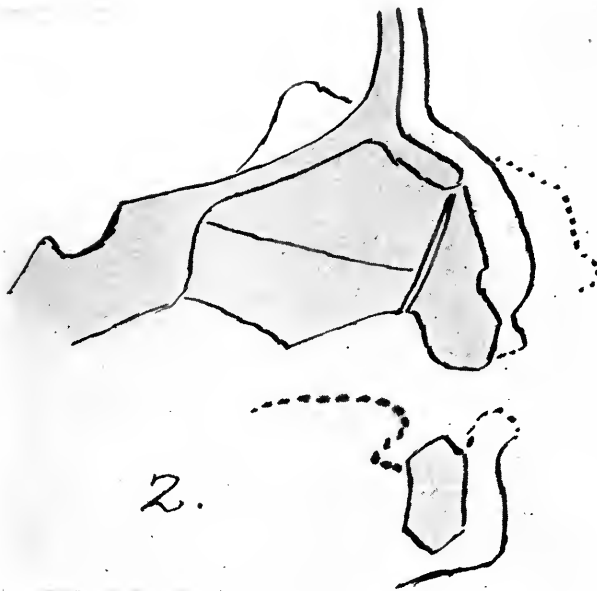


FIG. 3.—(2) Triangular resection showing how the projection of the nose is effaced after the pulling back. Process that must not be employed.

closed. (2) The cutaneomucous line must be rectangular. (3) The muscles of the philtrum must be very living, to assure the continuity of the orbicular. (4) The mucosa must be quite apparent, projecting, without a notch in its lower edge. (5) The totality of the lip must be neither restrained nor flattened.

The remaking of the lip will have for object to reconstitute the three elements of the region—skin, muscle, mucosa.

1. *The Skin.*—The easy part—all processes are good, all the incisions can be utilized. It is of first importance to make the incision in the skin itself, but away from the mucosa to avoid with certainty the piece of mucous mem-

# TREATMENT OF COMPLETE DOUBLE HARELIP

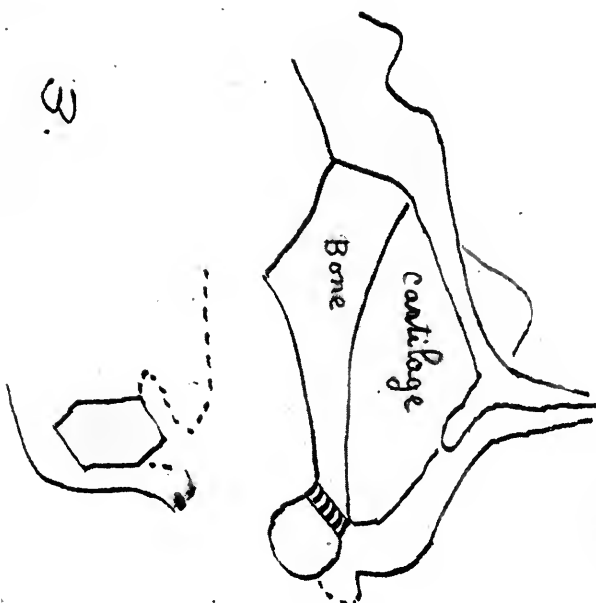


FIG. 3.—(3) Good incision of the neck of the bone of the premaxilla, the projection of the nose is not modified.

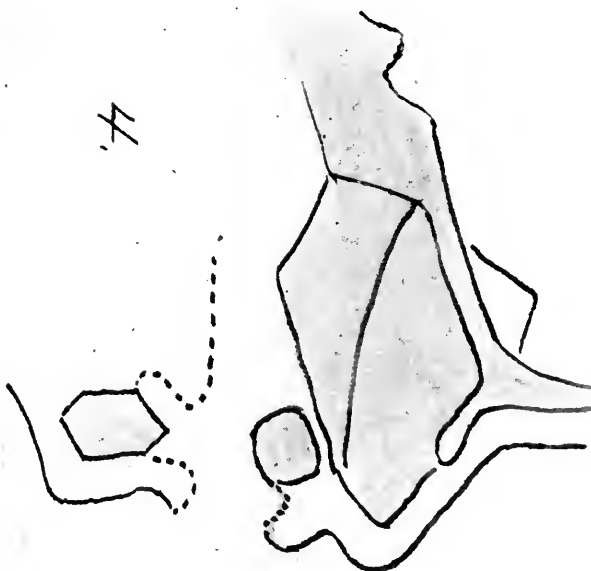


FIG. 3.—(4) Showing how the mucosa of the lower edge of the premaxilla will constitute a deep layer for the flat pieces of the skin sutured on the median line.

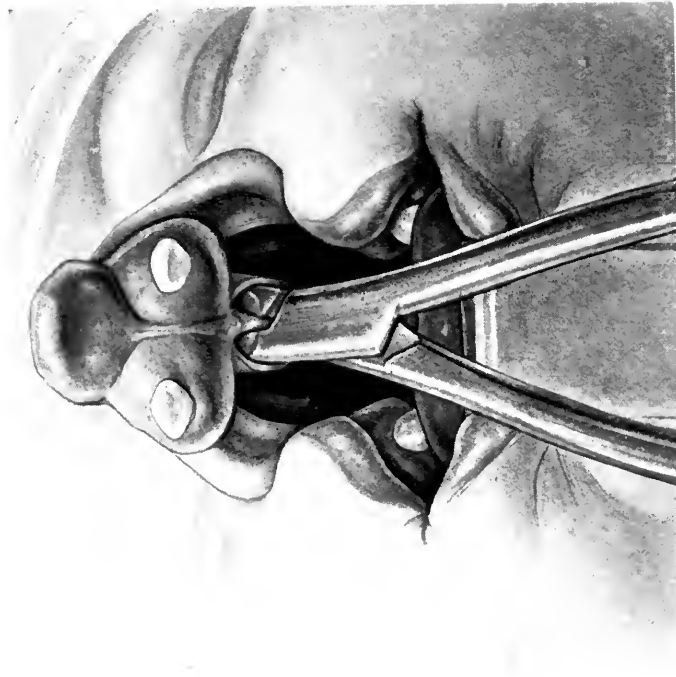


FIG. 4.—Section of the neck of the premaxilla.



FIG. 5.—Fixation of the premaxilla. The perforator is introduced between the bone and the soft parts and is directed toward the columella.



# TREATMENT OF COMPLETE DOUBLE HARELIP

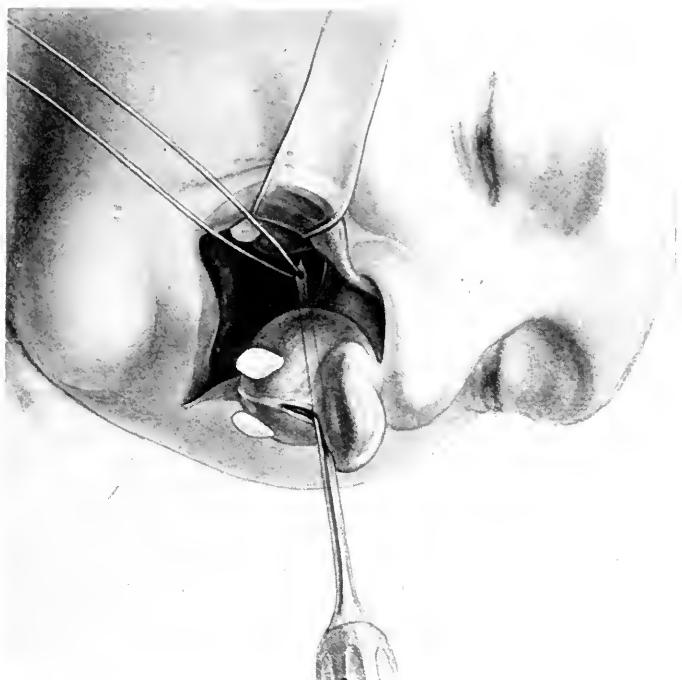


FIG. 6.—The perforator is raised, its point is pushed back behind the premaxilla and threaded with a silver thread at its point.

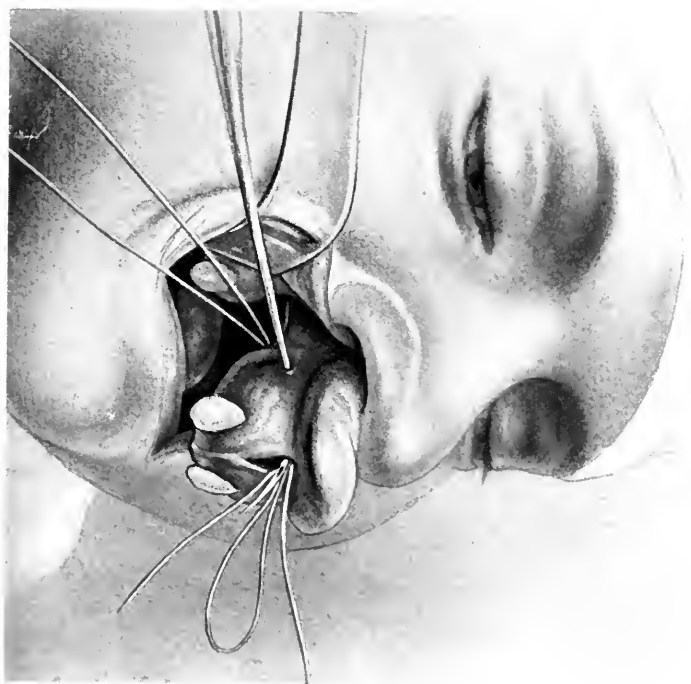


FIG. 7.—One of the threads is drawn back to the side.

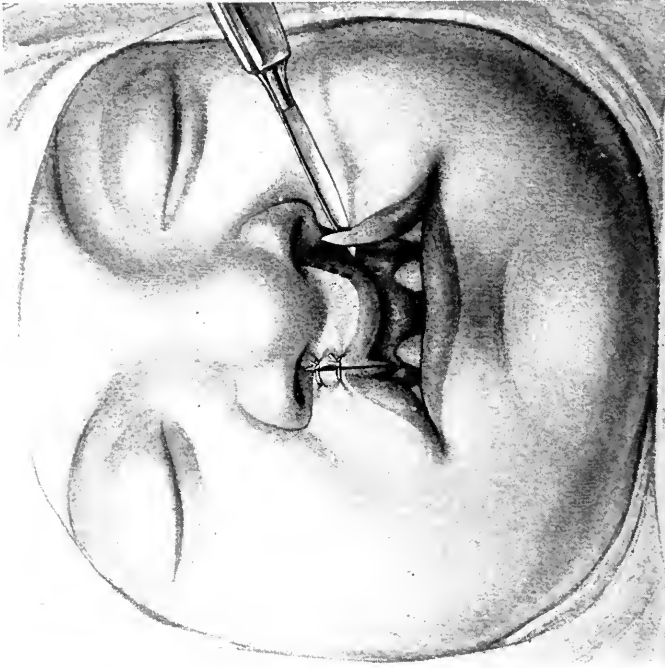


FIG. 9.—Refreshing the mucocutaneous edge of the lip.

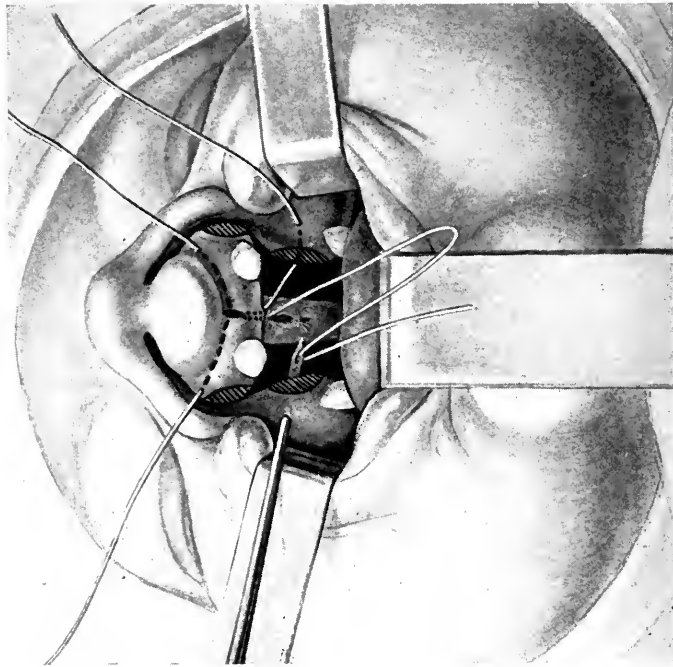


FIG. 8.—The silver threads are passed into the maxillary process.

# TREATMENT OF COMPLETE DOUBLE HARELIP

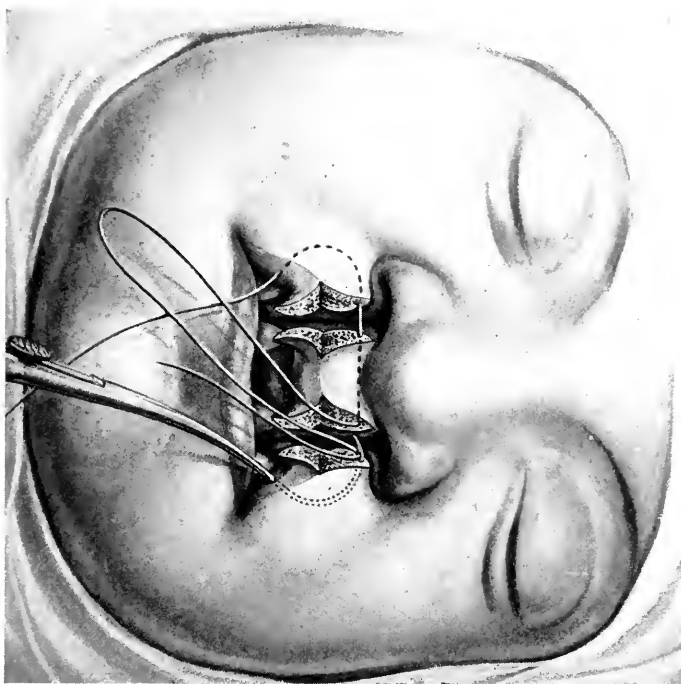


FIG. 10.—The skin suture. Note the through transverse suture perforating all the elements of the lip involved.

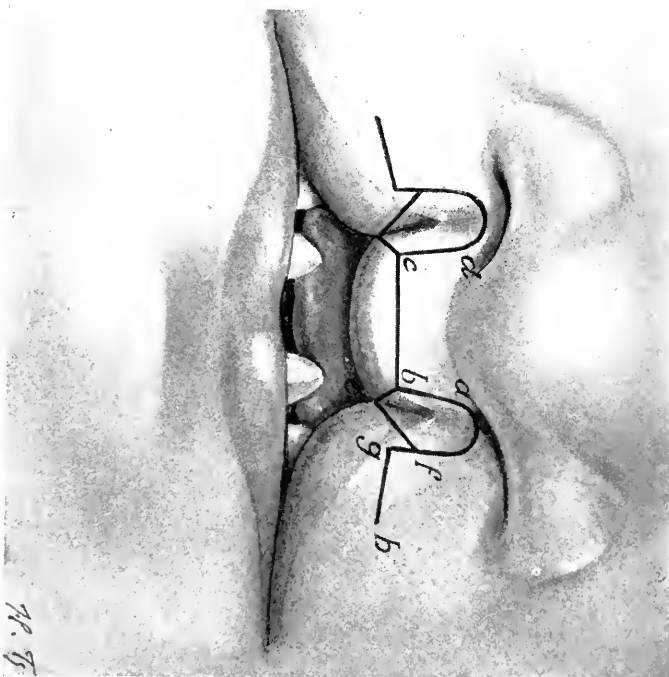


FIG. 11.—Second operation. The skin incisions.

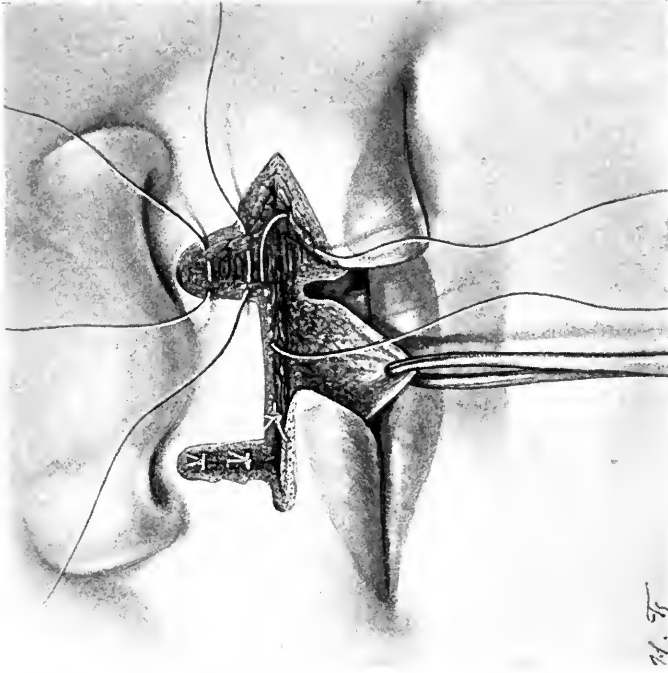


FIG. 13. The suture of the muscles.

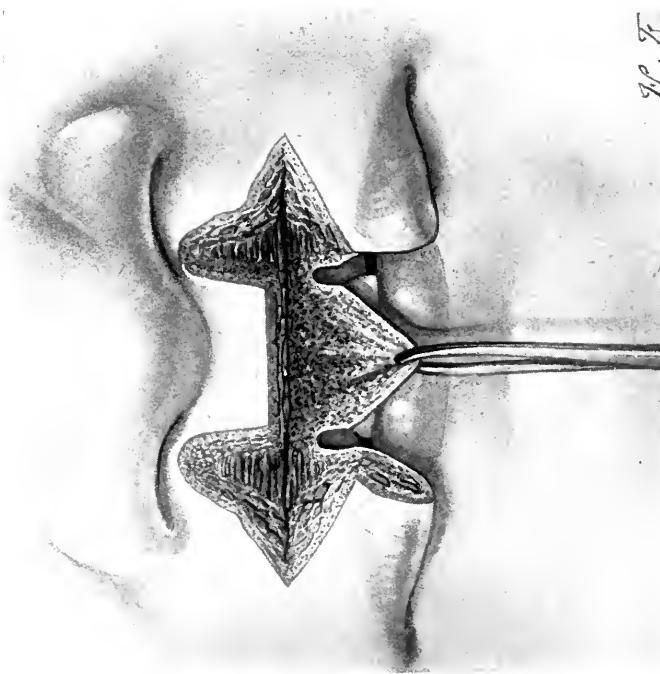


FIG. 12.—The skin incisions completely exposing the muscular elements of the lip which are to be carefully conserved.

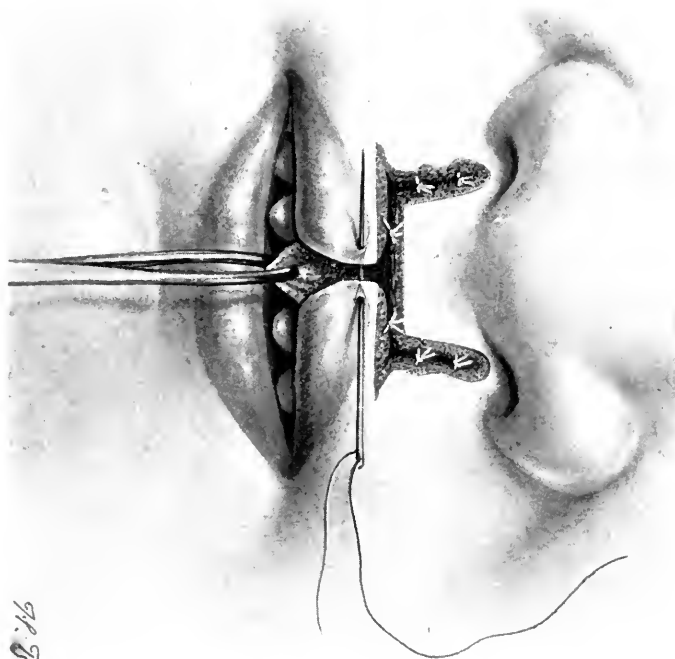


FIG. 14.—The suture of the skin. The important first stitch placed accurately on the mucocutaneous line.

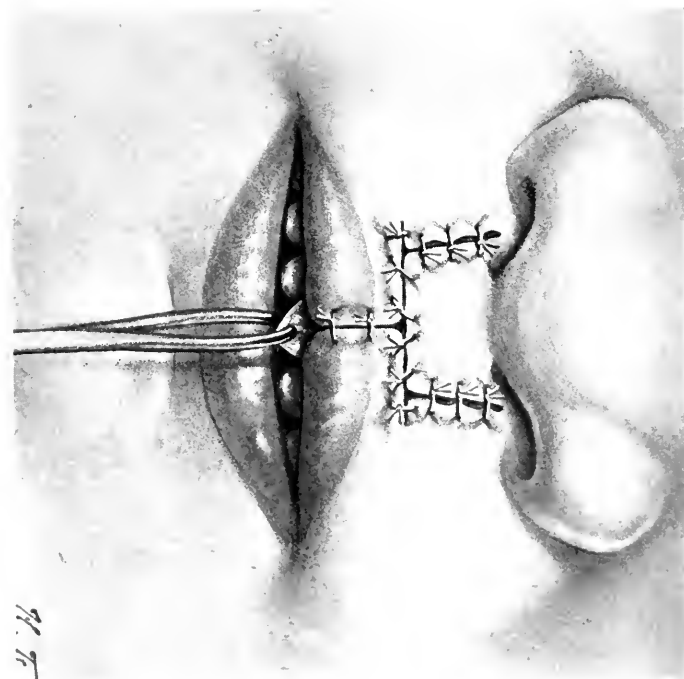


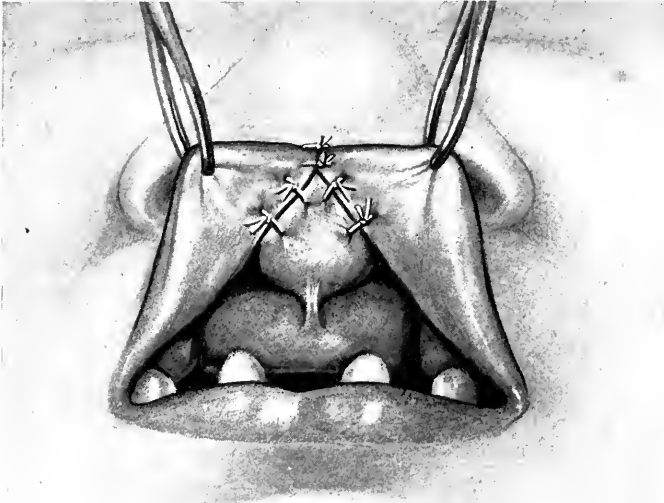
FIG. 15.—The suture of the skin completed.

brane that remains, which is a very great mistake. The lip is nearly always too high because the atrophied philtrum becomes larger afterwards.

2. *The Muscles.*—The most important part—they must be reconstituted carefully to give the suppleness of the lip.

3. *The Mucous Membrane.*—The difficult part. The taking away of the mucosa of the philtrum is the chief fault of the classical operation (Fig. 2). It is the lack of mucous membrane that gives the flattening of the lip. Ferguson has not fallen into the classical error.

*Technic.*—Figure 11 indicates the line of incision. With the bistoury you trace the line c.b. in taking great care: (a) that this line passes away



from the mucous part, (b) that the bistoury only cuts the skin, (c) that the angles b.c. are very clearly cut at right angles.

At the level of the lower edge of the philtrum the totality of the muscle must be conserved (Fig. 12).

The cutting of the lateral part is done in commencing by the line e.f. which includes the whole of the mucous membrane with about

*V.F.*

FIG. 16.— The suture of the mucous membrane. Note especially the manner in which the philtrum is included in the suture.

two millimetres more of skin. It must be perpendicular in the direction of the lip. The incision will include the inner and outer mucous membrane.

When the bistoury arrives at the point f. it makes the line f.g. three millimetres long which approaches the cutaneomucous line, but must never cut this line. This little angle will give to the median part of the lip a slight bend which will especially contribute to its beauty.

The line g.h. will be drawn obliquely in leaving progressively the mucous membrane. Its length has no importance; its object is to diminish the tension of the suture of the skin; it can be lengthened afterwards.

After having cut one side, the other is cut. It is very important that

the two lines f.g. have the same length. The lines g.h. can have different lengths.

The part included between the points b.a.f. will be taken away, taking great care to penetrate into the nostril in order to diminish the spreading out of the nose to be certain that the whole of the mucous membrane is taken away, but the buccal mucosa must not be cut.

When all the incisions are traced, you have the large wound represented by Fig. 12. A pair of forceps are placed on the mesial part of the philtrum, which is drawn into a triangle because it is very elastic.

(c) *The suture of the muscles* (Fig. 13) must be done with great care on the lateral parts and on the lower part to give homogeneity to the lip. I employ the finest catgut.

(d) *The Suture of the Skin.*—At this moment the edges are in contact. The suture must be made with the greatest precision. I employ Carrell's needles and vascular silk. The first stitch is the most important (Fig. 14); it must be placed exactly on the cutaneomucous line. The lower edge of the philtrum will be stitched afterwards, and, lastly of all, the lateral parts.

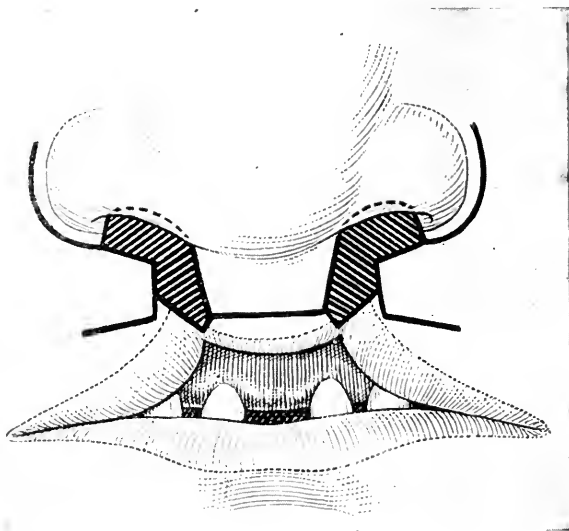


FIG. 17.—The correcting of the spreading-out of the nostrils, incision of the nose combined with the incision of the lip.

Generally the tension of the lip is such that the end h. of the lateral incision (Fig. 11) comes into contact with the lower lateral stitch of the philtrum, b. It is often unnecessary to make the vertical stitch represented by Fig. 15.

(e) *Suture of the Mucous Membrane.*—I employ fine horsehair, but these sutures have not the importance of the sutures of the skin, because there is no apparent scar on the mucous membrane. You can always put two stitches on the extremity of the side pieces of skin; they must be deep, taking in muscle which is underneath.

The lower part of the philtrum, which is situated behind, must be sewn as it is represented in Fig. 16.

To fight against the traction, I am accustomed to place a silver thread across the lip as is shown in Fig. 10.

The consecutive care will be the same as that given after the first operation.

*Accidents—Imperfections.*—*Disunion* is observed sometimes after the first operation. Nearly always it is produced on one side. A few months after a new suture is made.

*The spreading out of the nostril* is an almost inevitable accident. When it is not too noticeable it can be left. But sometimes it is very ugly; it should then be remedied by a second operation. It is sufficient to trace the incision as it is represented in Fig. 17.

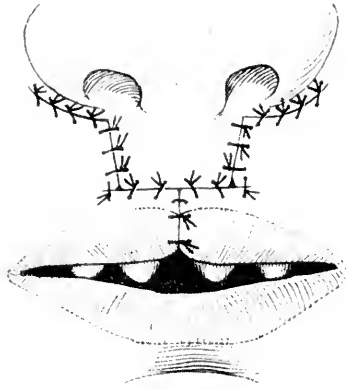


FIG. 18.—The suture of the incisions of the nose and the lip.

If it is produced after the second operation, it is necessary to operate again to bring it inside to the edge of the nostril by tracing a piece of skin as it is shown by the same figure.

*The median notch* of the lower edge of the lip has often been observed by me before placing the big silver thread (Fig. 11). It is easy to correct by a slight operation.

The surgeon must not neglect the ultimate treatment of his patient. The phonation will be much ameliorated in giving to the lip a sufficient suppleness by massage by spontaneous movement. The mastication is

always defective because the teeth of the premaxilla cannot be used; it is necessary to wear an apparatus.



## EXPERIMENTAL RECONSTRUCTION OF THE ŒSOPHAGUS WITH AUTOGENOUS FASCIA LATA TRANSPLANTS

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A MOST important factor in surgery of the œsophagus is infection. It merits emphasis. The explanation for this is anatomical—the œsophagus traverses the mediastinum. The fascial planes and structures which surround the œsophagus tend to parallel it. It follows, therefore, that it is the rule for an infection along any part of the œsophagus to lead to a mediastinitis or to a mediastinitis associated with a general empyema. This is usually fatal.

The sources of this infection are two-fold; first, autoinfection from the epithelial surfaces which must be dealt with in the various procedures of œsophagoplasty; second, from the external sources conveniently termed "faulty technic." Of these two sources, first mention belongs to autoinfection.

I. *Autoinfection*.—(a) The chief source of autoinfection is from the epithelium lining the œsophagus—in other words, *leakage of the contents of the œsophagus*. Whether this leakage takes place at the time of operation or subsequently, the result is the same—infection. C. H. Mayo,<sup>24</sup> J. B. Murphy,<sup>28</sup> Bevan<sup>5</sup> and others have directed our attention to the necessity for avoidance of opening the œsophagus in the comparatively simple operation for diverticulum. The recognition of the importance of autoinfection here has changed the risk in this operation sufficiently to remove it from the class of the hazardous to that of the safer operations.

The importance of autoinfection is equally true with resection of the œsophagus for carcinoma, yet the majority of the usual operative procedures for the reconstruction of the œsophagus contemplate not only resection of a portion of the lumen of the œsophagus, but also a further handling of these remaining cut ends in the transplanting of them from an intra- to an extra-thoracic position. This soiling of the operative field has been only too frequently followed by a mediastinitis and death.

Willy Meyer<sup>25</sup> noted the presence of "infected serosanguinolent exudate" which he had observed post-mortem in the mediastinum and pleural cavities after resection and transplantation of the thoracic œsophagus. Here special mention was made of the observance of "perfect asepsis" at operation. It is entirely probable that the infection which occurred was the result of opening the lumen of the œsophagus and further manipulation of these cut ends with the consequent unavoidable soiling of the field. This in spite of the diligence of one of our most careful surgeons.

(b) Another source of autoinfection is from the transplants of epithelial lined tubes of the viscera or the entire viscus which is to replace the resected

portion of the cesophagus. These are never sterile. This fact has been largely responsible for the development of extrathoracic cesophagoplasty whereby the potential infection is brought nearer the surface and into a far less vital region.

It is impossible, of course, to remove a cancerous growth of the cesophagus surgically without opening the lumen of the cesophagus; but it is possible to avoid all handling of these cut ends and all soiling of the field of operation by

the contents of the cesophagus both at the time of operation and subsequently. Moreover, it is possible to avoid the use of unsterile epithelial grafts in the reconstruction of the defect produced by resection of a portion of the cesophagus.

These points are emphasized in an operative procedure which we have worked out experimentally and will be discussed later.

II. *Faulty Technic.*—(a) The second possible source of infection we will place under the elastic caption of faulty technic. The fact that infection of the tissues surrounding the cesophagus is attended by such grave results makes it ultra-imperative that the *best* rules of aseptic surgery be strictly observed. We are wont to consider this aseptic technic as being best exemplified in “no hand touch” surgery. This should be observed insofar as it is possible.

It is not our intention to outline the principles of “no hand touch” surgery—that is common knowledge



FIG. 1.—A photograph of the epithelial surface of a 47-day dog resection, semi-circumference, with fascia lata transplant. Note that the suture line is outlined by ulcerations and that the linen suture remains. The epithelium has grown over the defect.

—but we would like to present a refinement for this technic. In our work we found it desirable to use the single suture. This we were unable to do without handling the suture needle with the gloves. To overcome this we then designed a needle which would not become unthreaded.<sup>1</sup> The needle can be easily threaded with the forceps; and in sewing it is found to lend itself readily to handling by forceps alone. All knots are tied with forceps.

The operation for resection and reconstruction of the cesophagus is in its infancy. In the literature one cannot fail to be impressed by the recent dates of all experimental data and case reports. The greater majority of these have been reported within the last fifteen years. There have been, however, a large number of operations devised to accomplish this result. None of these is entirely satisfactory.

## RECONSTRUCTION OF THE OESOPHAGUS

For the sake of brevity, the basic operative procedures which have been devised for oesophagoplasty will be tabulated without discussion.\*

- (1) Cervical oesophagoplasty by means of *skin-plasty* (v. Hacker, 1886).<sup>13</sup>
- (2) Extrathoracic oesophagoplasty by means of *skin-plasty* of neck and anterior thorax (H. Bircher, 1894).<sup>6</sup>
- (3) Inferior extrathoracic oesophagoplasty by use of a *portion of the jejunum* (Roux, 1907).<sup>33</sup>
- (4) Inferior extrathoracic oesophagoplasty by use of a *portion of the jejunum and skin-plasty* (Wullstein, 1904).<sup>39</sup>
- (5) Inferior extrathoracic oesophagoplasty by use of a *portion of the transverse colon* (Kelling, 1911<sup>21</sup> and Vulliet, 1911).<sup>38</sup>
- (6) Inferior intrathoracic oesophagoplasty by use of *the stomach* (Sauerbruch, 1905).<sup>34</sup>
- (7) Inferior extrathoracic oesophagoplasty by use of a *tube of the anterior wall of the stomach* (Hirsch, 1911).<sup>18</sup>
- (8) Inferior extrathoracic oesophagoplasty by use of a *tube of the greater curvature of the stomach* (Beck, 1904,<sup>3</sup> Jiänu, 1912).<sup>19</sup>
- (9) Inferior extrathoracic oesophagoplasty by use of *the first horizontal portion of the duodenum* (v. Fink, 1913).<sup>9</sup>

Reconstruction of half the circumference of the oesophagus with fascia has been done by Razzaboni and Neuhof.

- (1) Cervical oesophagoplasty by use of *the sheath of the rectus and peritoneum* (Razzaboni, 1917).<sup>31</sup>

- (2) Cervical oesophagoplasty by use of *the fascia lata* (Neuhof, 1917).<sup>29</sup>

The procedures devised by Wullstein (No. 4) and by Beck and Jiänu (No. 8) have been the most popular. All the procedures for the reconstruc-

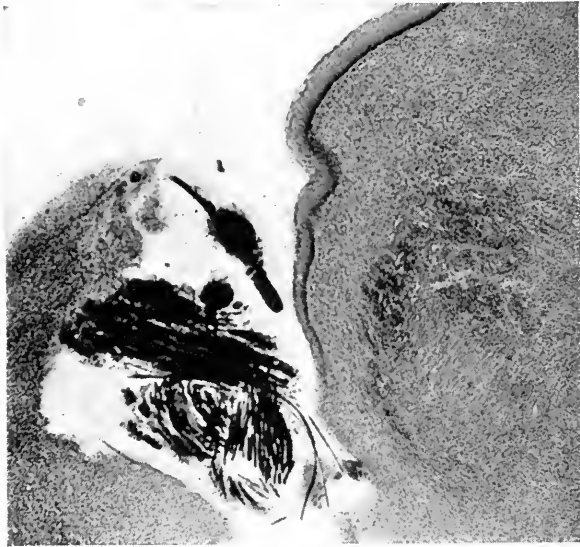


FIG. 2.—A microphotograph from the edge of an ulceration shown in Fig. 1. The linen suture marks the edge of the growing epithelium.

\* Since writing this article, our attention has been called to an excellent case report and new two-stage procedure for resection of the oesophagus, described by Dr. Howard Lilienthal, ANNALS OF SURGERY, vol. lxxiv, pp. 259-279, 1921. Skin flaps are used instead of fascia, and the oesophagus is approached through the posterior mediastinum.

tion of the entire lumen of the œsophagus have three undesirable features in common. They are complicated for execution; they require months for completion; and they are attended by a high mortality.

We believed there was a need for a more reliable, less complex procedure for reconstruction of the œsophagus. This seemed worthy of experimental investigation.

The material of choice for repair of defects in the œsophagus must possess a considerable amount of strength, must be pliable and must lend itself to

transplantation. The epithelium and tubular viscera have these requirements, but they are unsterile; fascia possesses these requirements, is sterile, and in addition will unite firmly and readily with the muscular wall or, more specifically, with the adventitious layer of the muscular wall of the œsophagus.

Neuhof<sup>20</sup> and Razzaboni<sup>31</sup> have used fascia to repair experimental defects of the œsophagus in the dog. Neuhof sutured the fascia lata *into* the defects; Razzaboni filled in the defects of the œsophagus with a double layer of the inner sheath of the rectus and its peritoneum. Each succeeded in repairing defects of approximately half the circumference, but neither reconstructed the entire circumference of the œsophagus. Neuhof found slight stenosis in his younger experiments and still less stenosis in the older experiments; Razzaboni found marked stenosis in all his experiments.



FIG. 3.—A photograph of the interior of the œsophagus with resection of half the circumference. Sutured with oo plain catgut with loosening of fascia. Marked stenosis.

#### PLAN

We hoped to be able to work out first the cause or causes for the differences in the degree of stenosis, then to work out a safe method for reconstructing the entire circumference of the œsophagus with fascia lata. We considered it best to reconstruct first the semicircumference of the œsophagus in its cervical portion, then in its thoracic portion. Both the successful and the non-successful experiments were to receive close study. Later we were to attempt the reconstruction of the entire circumference of the œsophagus with the fascia lata. Our experiments and ideas have, therefore, been of a progressive type and our results will be presented in like manner.

*Experiment A.*—The procedure in the cervical series of semicircumference resection is as follows, as carried out on the dog:

## RECONSTRUCTION OF THE ŒSOPHAGUS

June 13, 1918: Experiment A 1. Under aseptic conditions and with ether anæsthesia, a midline incision is made in the neck. The ribbon muscles are easily separated and the trachea is exposed. This is pulled to the right and the œsophagus is seen immediately behind. The œsophagus is grasped by forceps and is dissected out by gauze dissection. All the fascia lata is removed. It forms a rough rectangle about six by three cm. It is handled by small forceps at each of the four corners. The œsophagus is again picked up and two pairs of rubber-jacketed intestinal clamps are applied about 8 cm. apart. The field is packed off with gauze. Half the circumference of the œsophagus is resected for the length of 5 cm. The strip of fascia lata is brought into this defect and sutured in place with linen. A running mattress suture is used so as to bring the mucosa to lie against the fascia. This slightly everts the mucosa. The suture takes in all the walls of the œsophagus.

June 14, 1918: Dog listless. Nothing by mouth. Morphia freely.

June 15, 1918: More active, notices his surroundings. Water and milk by mouth. Neck swollen.

June 18, 1918: Liquid foods. Neck looks good.

July 3, 1918: Eats ordinary foods.

July 30: Killed at forty-seven days. Autopsy; The neck wound healed by first intention. The œsophagus is moderately firmly adherent to the trachea and there are adhesions to the surrounding tissues of the neck. The œsophagus easily admits the forefinger. When split open, the defect in the wall of the œsophagus is seen outlined by the uninterrupted linen suture (Fig. 1.) A row of ulcerations marks the presence of this suture. The defect appears to be covered over with new epithelium.

Microscopically: The stratified epithelium covers the entire defect, except for the ulcerations around the suture. The œsophageal muscle ends abruptly on both sides of the defect and between these ends connective tissue is found. There are no œsophageal glands beneath the new epithelium covering the connective tissue. A moderate amount of round and polymorphonuclear cell infiltration is seen throughout the connective tissue.

September 8: Experiment A 21. Usual procedure, except that instead of resection of half the circumference of the œsophagus, three cm. of the entire circumference is resected. The fascia is placed so as to make a tube entirely bridging over the defect. Number 1 hard intestinal catgut suture is used with a



Fig. 4.—A microphotograph of a section taken at "Y", Fig. 3, showing absence of fascia lata transplants. The edges of the normal mucosa have pulled together.

cobbler's stitch. Especial attention to asepsis. Fascial tube two cm. in diameter. Closed without drainage.

September 9: Dog listless. Nothing by mouth. Morphia freely.

September 10: Dog listless. Nothing by mouth; neck swollen.

September 11: Dog listless. Fluctuation in neck. Temperature 105°. Drank a few swallows of water.

September 12: Neck broken open at lower angle. Morphia freely.

September 13: Dog found dead this A.M. Autopsy: Neck full of foul-smelling, thin, creamy fluid—pus. Fascia lata tube entirely gone. There are no adhesions between the œsophagus and surrounding tissues of the neck. Mediastinum filled with the same foul-smelling pus, as are both the pleural cavities.

Diagnosis: Cellulitis of neck, mediastinitis, general empyema.

Microscopical: The mucosa, submucosa and muscle layers of the œsophagus are infiltrated with polymorphonuclear and small round cells. Marked necrosis of muscle and connective tissue at edge of section. No adhesions.

These two experiments are given as examples of the successful and unsuccessful experiments of this series of cervical resection.

Tabulated, the results are as follows:

TABLE I.

No.	Days	Epith. Overgrowths	Adh.	Half or Whole Lumen	Suture	Suture Ulcer	Infect. & Leakage	Killed Died	Solid Liquid Food	Cellul Neck Med is	Emp- yema	Strict- ure
1	47	++++	+	H	Linen	++++	O	K	S	O	O	+
2	46	++++	+	H	Catgut	++++	O	K	S	O	O	O
3	10	++	+	H	Linen	++	O	K	S	O	O	O
4	5	+	O	H	Linen	+	O	D	L	+	+	O
5	32	++++	+	H	BVSilk	++++	O	K	S	+	O	+
6	46	++++	+	H	BVSilk	++++	O	K	S	+	O	O
7	3	+	O	H	2-20 Cg	+	O	D	L	+	+	O
8	14	+	+	H	1 plain	+	O	K	L	+	+	O
9	40	++++	+	H	Silk	+	O	K	S	O	O	+
10	7	++++	+	H	1 plain	+	O	K	S	O	O	+
11	28	+	+	H	1 plain	+	O	D	L	+	+	O
12	1	+	+	H	Silk	+	O	K	S	+	+	O
13	4	?	+	H	BVSilk	+	O	K	L	+	+	O
14	9	++++	+	H	BVSilk	++++	O	D	L	+	+	O
15	4	++++	+	H	OOplain	+	O	K	L	+	+	+
16	4	+	+	H	OOplain	+	O	D	L	+	+	O
17	3	O	O	H	OOplain	+	O	D	L	+	+	O
18	2	?	+	H	OOplain	+	O	K	L	+	+	O
19	12	++	+	H	OOplain	+	O	K	S	O	O	+
20	21	++	+	H	1 plain	+	O	K	S	O	O	O
21	5	+	+	H	OOplain	+	O	D	L	+	+	O
22	14	+	+	H	OOplain	+	O	K	S	+	+	O
23	1	O	O	W	Silk	?	?	K	L	?	O	O
24	4	O	O	W	Linen	+	+	D	L	+	+	O
25	3	O	O	W	BVSilk	+	+	D	L	+	+	O
26	5	O	O	W	2-20	+	+	D	L	+	+	O
27	6	O	O	W	1 plain	O	+	D	L	+	+	O
28	4	O	O	W	1 plain	O	+	D	L	+	+	O
29	7	O	O	W	1 plain	O	+	D	L	+	+	O

Two things are worthy of especial consideration in this series of experiments: First, the processes of repair of the resected and reconstructed œsophagus; and second, the causes for the mortality.

*Processes of Repair.*—Figure 1 is a photograph of the interior of the œsophagus in experiment A-1 at the end of forty-seven days. The patch of fascia lata is outlined by the linen suture. It is apparent that there is little or no stenosis.

Figure 2 is a microphotograph of a section taken at X. It is to be noted

that the squamous epithelium of the Œsophagus has grown over the transplant; and that the transplant itself has been largely replaced by connective tissue. There is a marked infiltration of round and polymorphonuclear cells. Ulceration is seen about the suture.

There seems to be no escape from the observance of two facts in this experiment: Firstly, that linen should not be used to suture the mucosa of the Œsophagus; and secondly, that fascia lata repair of the Œsophagus is *not* always accompanied by early stenosis.

Figure 3 is a photograph of the interior of the Œsophagus in experiment A-15. 00 plain catgut was used to suture the fascia lata transplant into the Œsophagus. At the end of nine days the epithelium has entirely bridged the original three cm. defect! Here is found the *most marked* stenosis of this series.

Figure 4 is a microphotograph of a section taken at Y. No trace of the fascia lata transplant is seen. It could not have been replaced by connective

tissue within nine days. The sequence of events here seems to be that the fascia lata transplant has become detached (and swallowed) after sufficient walling off had taken place to prevent a spread of leakage into the tissues of the neck. This new connective tissue has allowed the cut edges to become closely approximated during the resting period of the Œsophagus. As a result, the half circumference of the Œsophagus which was originally replaced by three cm. of fascia lata is now replaced by less than one cm. of connective tissue, over which the epithelium has already bridged.

Figure 5 is a photograph of the everted Œsophageal mucosa in experiment A-6 at the end of forty-six days. The finest blood-vessel silk was used to suture the fascia lata transplant to the Œsophagus. Ulcerations are seen around fragments of this suture material. The Œsophagus is dilated with a wisp of cotton. There is but little stenosis.

Figure 6 is a microphotograph from a section of a fourteen-day experiment, A-22, showing the junction of the fascia lata transplant with the normal wall of the Œsophagus. *a* is the normal squamous epithelium lining the Œsophagus; *b* is the duct of a normal Œsophageal gland; *c* is the newly formed epithelium; *d* is the fascia lata which is being rapidly replaced by new connective tissue; *e* is the muscle wall of the Œsophagus.



FIG. 5.—Photograph of everted Œsophageal mucosa. Note the presence of ulcerations about the finest blood-vessel silk suture.

Figure 7 is a microphotograph from the same section, showing the growing edge of the new epithelium. The distribution of the round and polymorphonuclear cell infiltration is of interest insofar as the section illustrates the rapid disappearance of cell infiltration under the new epithelium. There are no oesophageal glands in the region covered by the newly formed epithelium.

*Mortality.*—In those animals that died, autopsy invariably revealed a cellulitis of the neck with leakage of the contents of the oesophagus, a mediastinitis, and a double empyema. Any or all of these may have caused death.

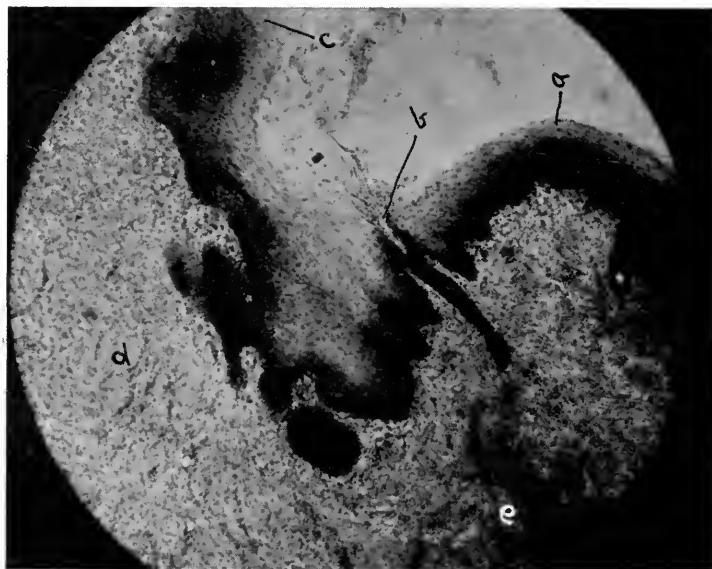


FIG. 6.—A microphotograph of the edge of the resection at the end of 14 days. *a* is the normal squamous epithelium of the oesophagus; *b* is the duct of a normal oesophageal gland; *c* is the newly formed epithelium; *d* is fascia lata and new connective tissue; *e* is the normal muscle wall of the oesophagus.

#### CONCLUSIONS

From this series of experiments the following conclusions were drawn:

1. That it is possible to repair defects in the wall of the cervical oesophagus by the use of autogenous fascia lata transplants.
2. That the stratified epithelium lining the oesophagus in the dog possesses the power of regeneration to a degree sufficient to enable it to bridge over defects which have been filled in with fascia lata transplants.
3. That infection along the cervical portion of the oesophagus may produce a mediastinitis or a mediastinitis associated with a general empyema.
4. That this infection is accompanied by leakage of the contents of the oesophagus.
5. That silk or linen should not be used for suturing the mucosa.



6. That stenosis may or may not be found after repair of defects in the wall of the œsophagus with fascia lata transplants.

*Experiments, Series AB.*—A second series of experiments for reconstruction of the thoracic portion of the œsophagus was then begun. In these it was proposed to carry on the same method of suturing the fascia lata transplant into the œsophageal defect as in the cervical series. The following description gives the general procedure:

September 27,  
1918: Experiment AB.

1. Artificial respiration and ether is being given by the Gezell positive pressure apparatus. An incision is made between the seventh and eighth ribs on the left side. Towels to skin. The ribs are spread apart by a rib spreader, the lung is packed away by sheets of vaselined vagus nerves and left silk. The heart, aorta, thoracic duct come into view through the pleura. The pleura is opened laterally to the œsophagus. The œsophagus is easily dissected loose by careful sharp dissection. There is very little bleeding. The chest is allowed to close and the field is covered with a sterile towel.



FIG. 7.—Microphotograph of the growing edge of the epithelium in the same section. Note the rapid disappearance of the round and polymorphonuclear cell infiltration under the new epithelium.

The fascia lata is removed from the leg. The ribs are spread again. The œsophagus is clamped between two rubber-jacketed intestinal clamps. The field of vaselined silk is packed off with gauze. A section of half the circumference of the œsophagus is removed for a length of 4 cm. The defect is filled in with fascia lata. Cobbler's stitch with No. 2 twenty-day catgut. The mucosa of the œsophagus is slightly everted. The pleura is closed over the œsophagus, bringing the œsophagus again to lie extra-pleurally. Under increased air pressure the lung expands to fill the entire chest. Chest closed air-tight, collodion dressing. Morphia freely.

September 29, 1918: Dog dead this A.M. Autopsy: The mediastinum is full of fluid with hair and débris. Evidently leakage from the œsophagus. The pleural cavities contain the same sour-smelling fluid.

Microscopical: The section shows a general infiltration of round and polymorphonuclear cells. There are no adhesions between the patch of fascia lata and

the œsophagus, nor are there any between the fascia and the surrounding tissue. The fascia is lying loosely against the mucosa of the œsophagus, but does not form a water-proof union.

It is highly desirable that we may be able to see and identify readily the various vital structures which are found alongside the œsophagus. None the least important of these is the thoracic duct. This can be visualized by feeding cream one-half hour before operation.

This series of seventeen experiments of intrathoracic resection pursued a uniformly fatal course and need not be tabulated. However, from them we were able to deduce certain conclusions.

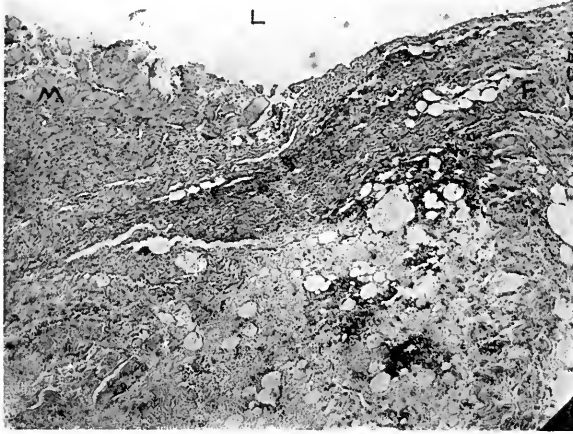


FIG. 8.—A microphotograph showing the leak-proof adhesions between the fascia lata transplant and the wall of the œsophagus at the end of 8 days. Resection of the œsophagus can safely be accomplished after these adhesions have formed.

Resection of a few centimetres of the entire circumference in the cervical œsophagus had always proven fatal; and at autopsy infection and leakage had been found. Likewise, the mortality of intrathoracic resection had been one hundred per cent.; and autopsy had revealed infection and leakage. Had the leakage caused the infection, or had the

infection destroyed the fascia to cause the leakage? That we were unable to work out definitely in the cervical series since the animal survived for a period of from three to seven days and at autopsy the fascia was either necrotic or missing.

When, however, intrathoracic resection was done, exitus was found to take place in from twelve hours to two days. In *every* case the mediastinum and pleural cavities contained a large amount of creamy saliva with much detritus—such as hair and small particles of dirt—which could have reached these cavities in only one way—*through leakage of the contents of the œsophagus*. We felt justified, therefore, in concluding that, owing to the short time elapsing between the operation and exitus, infection was not the cause of this leakage; but that leakage of the contents of the œsophagus was an important factor in the production of infection.

Our efforts were then directed toward the prevention of this leakage. Various suture materials ranging from the finest blood-vessel silk to heavy linen, and from 00 plain catgut to No. 3—thirty-day chromic catgut, with combinations of all of these into double row sutures, were used. A metal tube was next used, over the grooved ends of which the mucosa of the

## RECONSTRUCTION OF THE ŒSOPHAGUS

remaining end of the œsophagus was tied with a purse-string suture. The whole repair and metal tube was then enveloped in a fascial sleeve. All of these failed to prevent leakage and infection.

In view of these facts, a careful study of the sections was made to determine, if possible, those factors which had been responsible for the prevention of leakage in the successful cervical experiments. It was seen in every successful early experiment that firm adhesions had quickly taken place between the cut edges of the œsophagus and the fascia lata transplant, or between

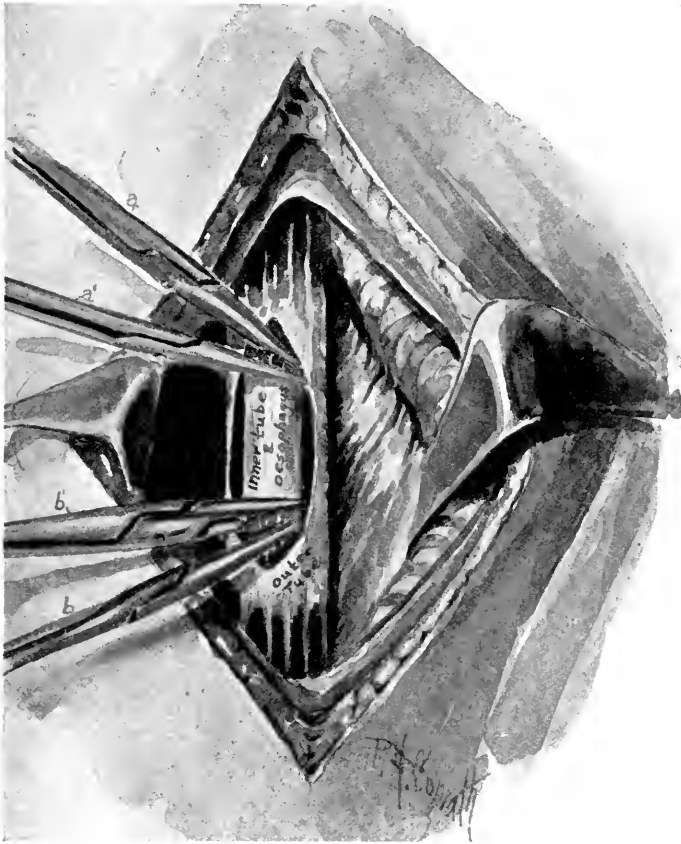


FIG. 9.—A drawing showing technic of removal of a portion of the œsophagus at the second operation. Leakage is guarded against by sewing the split in the outer sleeve of fascia *before* removal of the clamps a and b which are then removed from between the stitches. The clamp, b, on the distal end of the œsophagus is removed and the small opening here is sutured *before* the clamp a is removed.

these edges and the surrounding tissues of the neck; and it was apparent in the unsuccessful experiments that adhesions had not formed. It was decided, therefore, to allow these adhesions to form before opening the lumen of the œsophagus. This was to be attempted by a two-stage operation.

*Two-stage Operation.*—At the first operation two tubes of fascia were

to be placed around the entire circumference of the œsophagus. These were to be superimposed upon each other to form an inner and an outer tube.

The inner tube was to serve only a temporary purpose: to prevent that portion of the œsophagus which was to be removed at the second operation from becoming adherent to the outer tube of fascia lata. It was to envelop only this portion of the œsophagus.

The outer tube of fascia lata was to serve a permanent purpose: to be substituted for the resected lumen of the œsophagus at the second operation. The outer tube of fascia lata was to be longer than the inner tube. The ends



FIG. 10.—A microphotograph showing reinforcement of the suture line in the fascia transplant at the second operation.

of the outer tube might then become adherent to the ends of those portions of the œsophagus which were to be left after resection.

At the second operation the outer fascial tube was to be split longitudinally over that portion of the œsophagus which was to be removed. This portion of the œsophagus along with its adherent inner tube of fascia lata was to be resected. Care was to be exercised to prevent breaking of the adhesions between the ends of the outer tube of fascia lata and the œsophagus. Care was also to be taken to prevent breaking of the adhesions between the outer tube and the tissues of the neck. By these means it was hoped at the second operation to substitute *immediately* a growing tube of fascia lata for the portion of the œsophagus resected, and to prevent soiling and leakage.

This procedure was to be tried out experimentally first in the more accessible cervical œsophagus and later in the thoracic portion of the œsophagus, as in the preceding two series of experiments in which the semicircumference had been reconstructed.

The procedure in the cervical experiments is as follows:

October 23, 1920: Experiment A-05. Operation No. 1. Under ether anesthesia a midline incision is made in the neck. The œsophagus is dissected out for about 7 cm. The fascia lata is removed from both legs. Two tubes are made from the pieces of fascia and placed around the œsophagus with the muscle side of the fascia in. Care is used to see all of the fat has been removed from the fascia. The ends of the tube are anchored to the œsophagus by interrupted sutures. Two plain catgut. The neck is closed with drainage. Morphia freely.

October 24, 1920:  
Drainage tube removed.

November 1, 1920:  
Wound healed. Dog fine; can take only liquid food.

November 2, 1920:  
Operation No. 2. The fascial tube is identified by its whitish color. It is firmly adherent to the œsophagus—so much so, in fact, that it is difficult to determine just where the ends of the fascial tube are. An incision cuts through the outer tube. The muscle walls of the œsophagus are found. A contraction can be elicited by a sharp prick of the knife. The œsophagus is doubly crushed and clamped at the lower end of the portion to be removed; then two more clamps are firmly applied at the upper end. Excision between both sets of clamps (Fig. 9). (Carbolic and alcohol.) Two plain catgut is used in a cobbler's stitch to suture the split in the fascial tube. This suture is begun immediately distal to the forceps which clamps the upper cut end of the œsophagus. Great care is exercised to avoid soiling of the field from the cut end of the œsophagus. The cobbler's suture is continued to the lower forceps, which is now removed. The lower angle of the split in the fascial tube is closed and one stitch beyond is taken. Stitches are placed to close the upper angle of the split in the fascial tube. The forceps is now removed from the œsophagus at this point and these stitches are immediately tightened. A second continuous suture is



FIG. 11.—Photograph of the stomach and œsophagus of a dog. Killed 7 days after the second operation and filled with water under pressure. Note that leakage does not take place. (Neck resec.)

to suture the split in the fascial tube. This suture is begun immediately distal to the forceps which clamps the upper cut end of the œsophagus. Great care is exercised to avoid soiling of the field from the cut end of the œsophagus. The cobbler's suture is continued to the lower forceps, which is now removed. The lower angle of the split in the fascial tube is closed and one stitch beyond is taken. Stitches are placed to close the upper angle of the split in the fascial tube. The forceps is now removed from the œsophagus at this point and these stitches are immediately tightened. A second continuous suture is

now placed so as to bring the loose connective tissue snugly over this suture line of the fascia lata (Fig. 8). The neck is closed without drainage.

November 3, 1920: Dog active. Wound looks good. Drinks milk.

November 5, 1920: Dog can drink, but cannot eat solids.

November 13, 1920: Dog killed.

Autopsy: The œsophagus is adherent to surrounding tissues of the neck. A thickening indicates the site of resection. There is no pus. The entire œsophagus and stomach is removed en masse. The œsophagus does not leak at the site of resection. The lumen is patent. The inside of the œsophagus shows three-quarters cm. of new epithelium from the cut edges. Particles of food and hair are lodged on the connective-tissue tube which replaces the resected œsophagus. There is no mediastinitis or empyema.

Microscopical: The sections taken at the cut edges of the œsophagus and at the edge of the growing epithelium are practically identical with those of figures 6 and 7, respectively.

A. T., 1 (April 1, 1921): Rigid asepsis. With artificial respiration and ether, the left chest is opened between the sixth and seventh ribs. A double sleeve of fascia lata is placed about the œsophagus. One plain catgut is used on all sutures of the fascia excepting for the anchor sutures at the ends of the tubes of fascia lata. The anchor sutures are of interrupted black silk. The chest is closed without drainage.

April 2: Dog active; respiration 48 per minute; temperature, 100.2. Appears to be in little pain.

April 6: Friction rubs heard over chest. Dog eats liquids only.

April 8: Operation II. The left chest is again opened. The costal and visceral pleuræ are firmly adherent throughout the greater part of the left chest. The adhesions are carefully broken up. The black anchor sutures make it easy to distinguish the ends of our fascial tubes. (A bougie passed through the mouth and down the œsophagus is of great service in locating the transplant.) The inner tube of fascia and a portion of the entire circumference of the œsophagus is removed between clamps as in the preceding cervical experiments. Care is exercised to prevent soiling from the cut ends of the œsophagus. Two-twenty catgut for closing the outer tube of fascia. The chest is closed *without* drainage. April 9: Dog listless. Morphia freely. April 10: Milk and water by mouth. April 30: Dog killed.

Autopsy: The left lung is firmly adherent to the costal pleura. The œsophagus is found imbedded in adhesions. These are easily broken up and the œsophagus removed in toto. A No. 16 French catheter can be passed through the reconstructed portion of the œsophagus. Under marked pressure the reconstructed œsophagus does not leak water.

Twenty-two experiments for resection of the entire circumference of the œsophagus were done. Tabulated, see Table II.

There are three considerations of moment in these two series of experiments in which the entire circumference has been resected. The first is the process of repair; the second is the occurrence of stenosis; and the third is the freedom from leakage.

(1) The process of repair in the two-stage operation with the resection of the entire circumference of the lumen is similar to that in the one-stage operation of series "A." There are, however, certain distinct differences.

In the present series A-O and AT the overgrowth of the epithelium across the defect must take place from the cut ends of the normal mucosa. It does this readily, for a growing matrix of fascia lata and newly formed connective tissue has been established *before* creating the defect in the epithelium. In experiment A-09 this is found to have bridged across four cm. of the entire circumference of the Œsophagus within forty-four days. In the two-stage operation the fascia lata transplant cannot become loosened but remains *in situ*.

(2) In all experiments of these two series, A-O and AT, stenosis of the repair was found at autopsy. This invariably had been noted immediately after the first operation. It could not, therefore, have been the result of contraction of the connective tissue about the reconstructed portion; but was due, in part at least, to an insufficient diameter of the original fascia lata tube. In fact, on account of the relatively small size of the fascia lata, the dog does not serve admirably for a reconstruction of the entire circumference of the Œsophagus with fascia lata transplants. In those experiments where four or five cm. of Œsophagus was resected, it was found necessary to use both fasciæ latæ to form the outer tube. In these, no inner tube of fascia was made. The bougie was not used in any of our experiments, for we were desirous of knowing just how much stenosis might result. In experiment A-09, however, the upper two-thirds of the reconstructed portion was found at autopsy to be widely dilated. This dilatation had been produced by the presence of delayed food. It suggests the possibility of preventing stenosis by dilatation.

(3) Leakage of the contents of the Œsophagus both at operation and subsequently is prevented in the two-stage operation. Before the avenues for leakage have been opened, a walling off of this portion of the Œsophagus has taken place. Moreover, the tube of fascia lata transplant is already attached by water-proof adhesions to the ends.

Figure 8 is a microphotograph of a section through the end of the outer tube of fascia lata and the cut end of the wall of the Œsophagus in experiment A-02. "M" is the muscle wall of the Œsophagus, "F" the fascia lata transplant, "L" is the lumen of the Œsophagus. Note that there can be no leakage of the contents of the Œsophagus.

Figure 9 is an illustration of the technic of removal of the inner fascia lata tube and the section of Œsophagus. The Œsophagus is excised between the two clamps of each pair. The split in the outer tube of fascia lata is sutured before removal of the clamps a and b, which are crushing the remaining ends of the Œsophagus.

The longitudinal slit in the outer tube of fascia lata is sewed together by two twenty-day catgut, using a cobbler's stitch. This is placed as a continuous suture, but it is well to tie the two ends of the suture together at the completion of each second stitch. This suture line is then reënforced by a

TABLE II.

Experiment No.	Days after Oper. No. I.	Days after Oper. No. II.	Died or killed.	Infection after Operation No. I.	Infection after Operation No. II.	Leakage after resection. Mediastinitis.	Empyema: Double is	Stenosis after Operation No. I.	Stenosis after Operation No. II.	Esoph. fistula	Adhesions between ends tube and oesophagus.	Remarks
A-01	19	..	K	O	..	..	O	++	..	O	+++	
A-02	28	..	K	O	..	..	O	+++	..	O	+++	
A-03	9	7	K	+	+++	O	O	++	+	O	+++	
A-04	4	..	D	++++	..	+	++	++	..	O	+	Few
A-05	10	11	K	O	O	O	O	+++	+	O	+++	
A-06	9	4	D	O	+	O	++	++	+	O	++	Soiling by oesoph. contents at Op. I.
A-07	26	..	D	++++	..	+	++	++	..	O	+	
A-08	21	8	K	O	O	O	O	++++	++	O	+++	Gastrostomy kills.
A-09	31	44	K	O	O	O	O	++	+	O	+++	
A-010	30	4	K	O	O	O	O	++	+	+	+++	Fed bones by mistake:
A-011	30	2	K	O	O	O	O	++	+	+	+++	Bones by mistake.
A-012	34	1	K	O	O	O	O	++	+	O	+++	
A-013	10	..	D	+++	..	+	++	++	..	O	+	Mangy poodle.
A-014	6	26	K	O	O	O	O	++	+	O	+++	
A-015	4	..	D	+	..	+	++	++	..	O	+	
A-016	11	..	D	O	....	..	O	++	..	O	++	Autopsy: Abdominal hemorrhage. Cause unknown.
AT-1	7	22	K	O	O	O	O	++	+	O	+	
AT-2	3	..	D	+++	..	+	+	+	..	O	+	
AT-3	10	14	K	O	O	O	O	++	+	O	++	
AT-4	9	10	K	O	O	O	O	++	+	O	++	
AT-5	12	3	K	O	O	O	O	+++	+	O	+	
AT-6	2	2	D	O	++	+	+	++	+	O	+	Soiling at Op. 11. acct. crushing forceps improperly applied to oesophagus.

layer of the loose connective tissue which surrounds the tube of fascia lata. It is brought to lie snugly over the suture line of the fascia lata transplant.

Figure 10 is a microphotograph of a transverse section of the outer tube of fascia lata in experiment A-012. The experiment was sacrificed at the end of one day. The method for reënforcing the suture line is clearly shown. *A* is the line of suture of the outer tube of fascia; *b* is the line of suture of the loose connective tissue which is brought across and seals the suture line of the fascia lata transplant.

Experiment A-03 illustrates the reliability of the method. Here the wound was infected at the first operation. In the presence of known infection, however, the second operation was done. The dog was fed liquid food on the following day. Endoscopic examination on the third day showed the lumen of the fascial tube to be intact. The dog was killed on the seventh post-operative day on account of the condition of the neck wound.



## RECONSTRUCTION OF THE ŒSOPHAGUS

The stomach and œsophagus is shown in figure 11. To obtain the distention, the stomach was filled with water through the pylorus. The œsophagus was clamped above the resection. The presence of the distention between the forceps and the reconstructed portion shows that the lumen of the fascial tube is patent. Under marked pressure the repair was found to remain water-tight.

The effectiveness of the two-stage operation in preventing leakage can well be seen by a comparison between the data in this series of experiments A-O and AT, and in those experiments of series A in which the entire circumference of the œsophagus was resected; in series A *all* experiments show spontaneous leakage, in series A-O and AT (two-stage) one shows spontaneous leakage.

*To Summarize.*—Infection plays a very grave rôle in surgery of the œsophagus. Autoinfection is of great consequence. Aseptic technic should be strictly observed.

The usual operative procedures for reconstruction of the œsophagus are dilatory and tedious, both for the surgeon and for the patient. They require from three to eighteen months for the completion of a serviceable œsophagus; they necessitate a series of separate operations. The post-operative mortality is high. A simpler, speedier and safer procedure for its reconstruction is much to be desired.

Fascia lata transplants possess the welcomed attribute of sterility. Reconstruction of the œsophagus with fascia lata transplants should not be attempted by a one-stage operation because of the danger from leakage of the contents of the œsophagus. By a two-stage operation, however, the fascia is allowed to seal itself to the œsophagus before the lumen of the œsophagus is opened. This prevents leakage and autoinfection.

Early stenosis may or may not result from repair of defects in the wall of the œsophagus by autogenous fascia lata transplants. This stenosis is augmented by early detachment of the fascia lata transplant. Detachment is guarded against by the two-stage operation. Early stenosis necessarily follows the substitution of a fascial tube with a lumen of insufficient diameter. The fascial tube should, therefore, have an equal, or better, a greater diameter than that of the œsophagus. Dilatation with the bougie seems feasible and should be started early after the second operation. In fact, we should strive to prevent the formation of stenosis rather than to try to correct it after it has occurred. The sections and specimens indicate the probability of safety for dilatation at the end of seven days.

### CONCLUSIONS

1. It has been shown to be possible to reconstruct portions of the entire circumference of the œsophagus with fascia lata transplants. The result is a tube lined with squamous epithelium derived from the epithelium which normally lines the œsophagus.

2. By the two-stage operation the danger from leakage of the contents of the œsophagus and autoinfection is reduced to a minimum.

NOTE.—This work was begun in 1918, but for various reasons was not completed until 1921. I am indebted to Dr. Ernest Sachs, at whose suggestion the work was begun, and to Dr. A. C. Brooks and Dr. G. K. Dickson for assistance in the experiments.

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## EXTIRPATION OF ONE (LEFT) ADRENAL GLAND FOR THE CURE OF EPILEPSY

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OF NEW YORK, N.Y.

UP to the present time the efforts of surgeons to cure epileptic convulsions have been mainly confined to operations on the brain and on the skull, with the very few exceptions in which peripheral irritation by old scars or by some nasal affection was held responsible for the production of the convulsions.

It is not possible for me to enter into a detailed description of the many theories which have been put forth to explain the causes of the malady; suffice it to say, that up to a recent date the seat of the disease by all investigators was thought to lie in the central nervous system, the brain.

Recently Heinrich Fischer<sup>1</sup> advanced a very interesting and new theory which he has substantiated by animal experiments. He found that *by reduction of adrenal substance in the animal body, the tendency to convulsions can be reduced.*

As these investigations give us an entirely new conception of the disease and shows us a new way to attack it, it is necessary for me to embody here the investigations of Fischer.

In the following I shall give an abstract of his publication "Ergebnisse zur Epilepsiefrage" which appeared in the Zeitschrift für die gesamte Neurologie und Psychiatrie, volume 56, 1920, as far as it is necessary.

Our modern conception of the nature of an epileptic attack was formulated at a time when we still believed that the symptom of convulsion constituted the disease itself. Today, it is a well known fact to the clinician that convulsion and "epilepsy" have not the same meaning.

Fischer proposes to substitute for the usual expression "epileptic convulsion" the word "elementary convulsion."

Diseases which are accompanied by elementary convulsions he includes under the heading "convulsive diseases." The most important of these "convulsive diseases" is the "common epilepsy." The increased ability of the animal body to respond with convulsive attacks he calls "Krampfbereitschaft" (readiness of the animal body to react with convulsions to irritation).

In future one ought not to be skeptical towards experimental investigation of convulsive diseases. The objection voiced against this form of investigation was that the experimentally produced convulsions had nothing in common with epileptic disease in man. This objection, of course, holds true. Con-

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<sup>1</sup> Heinrich Fischer: Ergebnisse zur Epilepsie Frage. Ztsch. f. d. ges. Neurologie u. Psychiatrie, vol. lvi, 1920.

vulsion produced by animal experimentation has just as little to do with epilepsy as a convulsion produced experimentally in the human being. However, it seems to him unjustified to draw such a rigid distinction between experimental convulsions based upon traumatism and intoxication in man and the experimentally produced convulsions in mammals. It seems to him possible to attack by experimentation not only the traumatic and toxic, but also the increased constitutional "krampfbereitschaft."

Experimental investigation of convulsive diseases must be regarded as an important step towards the exploration of these diseases.

Redlich and Vogt have laid stress upon the fact that the brain has the ability to react with convulsions to certain pathological stimuli.

Fischer goes a step further and states that this ability is not alone confined to the brain as such, but is a distinct form of individual reaction of the whole organism.

An important part of the convulsive mechanism is centred in the brain, which, however, is not the only point of attack. The effect of peripheral stimuli on the production of convulsive attacks and the quality of peripheral concomitant phenomena leads one to question the cerebral source of this convulsive mechanism.

Convulsions are, as far as we can judge, an expression of excessive labor performed by the striated muscular fibre and the production of convulsions is in turn dependent upon the functional ability of these fibres.

The question arises therefore, whether this excessive response of the muscular fibre to stimuli is entirely dependent upon central influences, or whether peripheral influences also play a rôle.

Numerous experiments have proved that there exists a close functional relation between muscular labor and the adrenals. Animals in which the adrenals have been removed show an increasing muscular weakness as the main symptom. In Addison's disease muscular asthenia is the foremost symptom. In animals without adrenals death is considerably hastened by forced labor.

In normal animals excessive muscular labor produces an increase in the production of adrenalin and during the stage of muscular exhaustion the

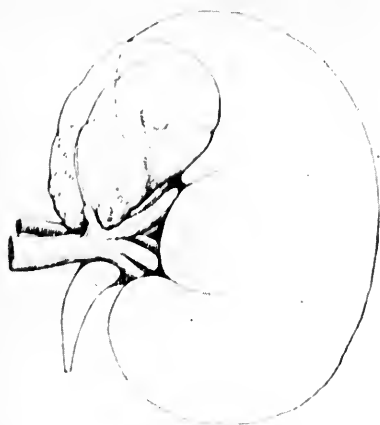


FIG. 1.—After Alberan.

chromaffine system is also exhausted. During recuperation the adrenalin content is increased and again reaches normal values after several hours. Experiments in animals have shown that the administration of adrenalin increases muscular function, which conforms with our experience in man. Langlois found that, as administration of adrenalin in Addison's disease brings the contraction curve of the musculature to normal, the subjective feeling of muscular fatigue also diminishes. In persons who have died after convulsive seizures the adrenalin content of the adrenals was found sub-normal. Roessle found in three cases of death during an epileptic attack large adrenals with fatty degeneration and with remarkably little medulla.

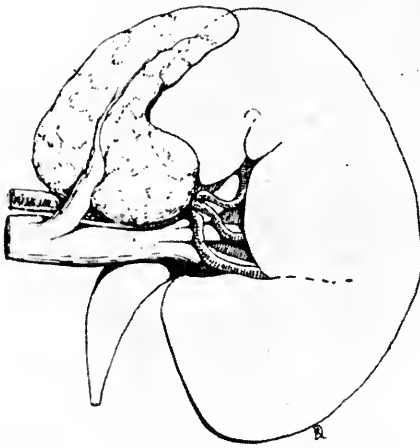


FIG. 2.—After Alberan.

Elliot and Tuckett made the important and interesting observation that the size of the adrenals in general increases with the size of the body and especially with the increase in muscular development in vertebrates. This increase is noticeable especially in the cortex. Guinea-pigs which have a great tendency to convulsive attacks are endowed with especially large adrenals.

This undoubted interrelation between muscular labor and functional activity of the adrenals induced Fischer to under-

take a series of experiments in rabbits in order to determine whether the chromaffine system plays a rôle in the mechanism of convulsions.

These investigations he undertook in 1913 and 1914 (not published as yet) and he thinks he has arrived at definite results.

*He could demonstrate that in rabbits the capacity for convulsions decreased with the decrease of adrenal substance.* If the substance of the adrenals was reduced considerably the tonic-clonic cramp was substituted by a coarse tremor of the extremities.

After extirpation of both adrenals administration of amyl nitrite did not produce any convulsions *if no accessory adrenals were present* in the body. Unconsciousness which usually accompanies the convulsions did not occur either. The destruction of *adrenal medullary* substance has no important influence upon the convulsive capacity of the animals. This fact of course, does not minimize the undoubted importance of the chromaffine system for

the production of convulsions. The secretory function of the chromaffine system is dependent upon the presence of *adrenal cortical substance*.

Animals which had been sensitized by electrical irritation of the brain cortex reacted stronger upon administration of amyl nitrite.

This traumatic hypersensitiveness of the brain could be reduced by diminution of the adrenal substance. The animals, however, continued to be more sensitive than the control animals with similar adrenal reduction. After removal of the total *cortical* substance of the adrenals these animals with traumatic cerebral hypersensitization reacted upon inhalation of amyl nitrite with only a few contractions which did not in any way resemble the convulsions of normal animals.

The conclusion could now be drawn that the capacity for convulsions by peripheral stimuli would increase in animals in which it was possible to produce, experimentally, a hyperfunction of the adrenal cortex. In these experiments Fischer made use of the fact that the adrenal cortex appreciably increases in volume in rabbits with chronic alcohol poisoning, and in rabbits which had been castrated.

By these experiments Fischer proved that the capacity of the body to react with convulsions is dependent upon a sufficient amount of functionally active adrenal substance. *The adrenals belong, probably inclusive of the whole chromaffine system in the body, to the convulsive mechanism.* His experiments have also shown that there exists a peripheral component of the cramp-mechanism in the body.

The peripheral component joins with the central component in the musculature by means of the peripheral nerves. On the other hand, there exists a direct continuation between the cerebral sympathetic system and the adrenals by means of the sympathetic nerves. The cortex of the adrenals, as part of the chromaffine system, is directly derived from the sympathetic. A complete cycle of the cramp-mechanism is hereby formed.

The important stations in this cycle are the brain, the adrenal system, and the musculature. The communication of the parts with each other is produced partly by the motor and sensory nerves, partly by the sympathetic, and partly by the blood as a carrier of hormones.

The possibility of a far-reaching interrelation between the peripheral and the central components of the cramp-mechanism is therefore evident. How-



FIG. 3.—After Alberman.

ever, one must not conclude that the patient who suffers from a convulsive disease must have a hypertrophy of the adrenals. A disturbance of function in the sense of a high nervous instability is sufficient to explain the phenomena.

This theory of Fischer's has been taken up by Brüning and put to a practical test in fourteen cases of severe epileptic convulsions, by removing a part or a whole of one adrenal gland. He reports: No mortality. Three cases are still under treatment. Of the other eleven patients five are cured, respectively. In one case attacks are less in intensity and duration but occur more frequently. No result in three patients (age 38, 52, 45) who had their attacks for a long time. It is characteristic of all cases that the attacks cease

immediately after the operation.

If new attacks occur they can usually be suppressed by administration of very small doses of Sedobrol or Luminal 0.05 t.i.d. whereas all these medicaments had no influence at all before the operation.

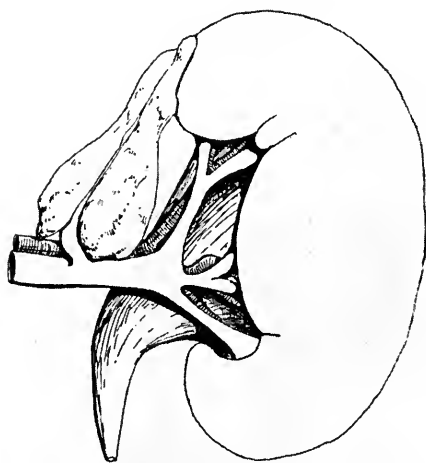


FIG. 4.—After Alberan.

W. G., twenty-five years old, has been suffering from epileptic attacks for sixteen years. His family history is negative as far as nervous diseases are concerned, with the exception of an uncle of his mother, who died of "softening of the brain." The beginning of his disease dates back to early childhood when he was subject to frequent attacks of convulsions. When seven years old he was hit by a trolley-car and pushed several feet; he did not sustain any injuries but was very much terrified by the accident. After this psychic trauma he began to have epileptic attacks more frequently and more severe. Slowly the disease progressed in spite of long treatment, medical as well as surgical. He now has ten to fifteen attacks every night; his psychical condition is deplorable. He had scarlet fever, whooping cough, measles and mumps. At seven years of age he had chorea which lasted one year.

Up to 1914 his attacks were of the type of epileptiform equivalents and petit mal; after that he had typical attacks of grand mal.

In 1910 circumcision, and in 1915 a subtemporal decompression on either side was done without giving any relief.

In January, 1921, the following case of epilepsy of long standing came under my observation. (Kindly referred to me by Dr. Ransohoff.)



## EXTIRPATION OF ADRENAL GLAND FOR EPILEPSY

In 1918, following a series of attacks, patient hallucinated for several days. Attacks are more frequent at night. Complaints of frontal headaches and occasional attacks of temporary blindness after attacks.

*Physical Examination.*—Well-built, well-developed young man of twenty-five, slow in coördination of speech and movements, rather expressionless face.

*Head:* Well developed, hair well distributed, scars of two operations for temporal decompression. Scar on forehead.

*Eyes:* Pupils react equally to light and accommodation, vessels normal, muscles normal, optic disc normal, a little pale on temporal side.

*Throat:* Small tonsils, slightly injected pharynx and tonsils.

*Teeth and Gums:* In excellent condition.

*Chest:* Well developed, of equal expansion.

*Lungs:* Resonant throughout and clear.

*Heart:* Sounds of good quality, not enlarged, no murmurs.

*Abdomen:* Normal.

*Extremities:* Normal.

*Reflexes:* Knee-jerks exaggerated.

*Genitals:* Normal.

*Wassermann:* Negative.

*Urine:* Reaction, acid; specific gravity, 1022; sugar, negative; albumin, negative.

*Chemical Blood:* Urea (12-15), 11.0; creatinine (0.5-2), 0.45; uric acid (1-2.5), 2.0; sugar, per cent. (0.08-12), .07.

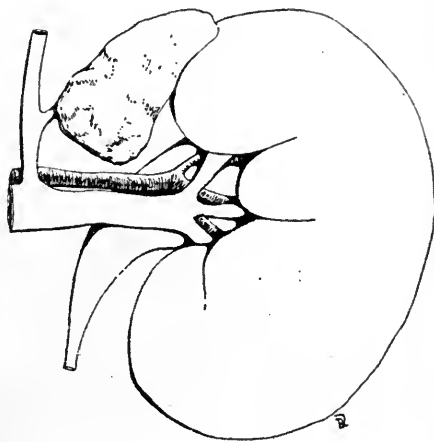


FIG. 5.—After Alberan.

*Sugar Tolerance Test:* Ingestion of 100 grams glucose. Before glucose, .102 per cent.; urine, negative; forty-five minutes after, .108 per cent.; urine negative; two hours after, .093 per cent.; urine negative.

*Typical Attack:* 1. Patient becomes rather quiet and usually, when a long series of attacks are to follow, patient sits quietly for days; then becomes cyanotic, sometimes has hacking cough just before attack.

2. Patient falls, becomes stiff and then has clonic contractions, at times froths at the mouth and bites tongue; this stage lasts one-half to one minute.

3. Patient then becomes restless and moves about in bed for a variable period of time (five minutes to several hours). When attacks are very severe patient usually screams and moans for hours.

*Endocrine Examination.*—(Doctor Blumgarten.) The patient is a rather dull, lethargic blond young man, slow and deliberate in his movements and in speech. The skin is markedly pigmented, especially around the lower abdomen, acne on back. There is a moderate growth of hair over lower abdomen, legs, thighs and buttocks. There is no Sergeant's line. There is a marked generalized adiposity. The head shows evidence of previous trephining operations. The forehead is prominent and broad. The lobes of the ear are attached to the side. The nose is normal, not unusually broad. The lips are thick and prominent. The teeth are in excellent condition, there is no increased interdental spacing, but the lower set comes directly in apposition with the upper.

The neck is short and stocky, the thyroid is not enlarged. Chest is broad, the costal angle is wide, the breasts are well developed. The extremities are normal, the hands are rather delicate, the fingers are long and pointed. No tremor, no cyanosis.

Span, 65½ inches; height, 5 feet 5⅛ inches; weight, 162 pounds; sterno-clavicular junction to malleolus, 52 inches; anterior superior spine to malleolus, 38 inches; upper extremities, 26 inches; torso (length), 7½ inches; pelvic width, 13 inches.

Sugar tolerance, slightly diminished; blood chemistry, slightly low sugar; pilocarpine test, negative; Goetsch test, moderately positive; blood-pressure—systolic, 85; diastolic, 55.

Conclusion: The patient is a pituitro-adrenal type.

As all attempts at a cure have been futile in this case and as the condition of the patient became worse and more deplorable every day, it was deemed justified to give this new operation a trial.

*Operation.*—February 12, 1921. *Extirpation of Left Adrenal Gland.* Typical lumbar incision (Bergmann-Israel) as in operation for nephrectomy with resection of twelfth rib.

After exposure of the fat capsule of the kidney, the kidney, together with its perirenal fat capsule, was dislocated downward by introducing one hand

FIG. 6.—After Alberan. 1. Low situation, more frequent, especially on left side. 2. High situation, only on right side. 3. Very rare.

into the wound and by tearing the loose areolar tissue between the diaphragm and the upper pole of the kidney capsule. By this manoeuvre the kidney could easily be pushed down far enough to expose the upper pole of the fat capsule. The perirenal fat capsule was now carefully separated with blunt forceps until the flat, greenish-gray adrenal gland was seen resting on the top of the kidney. The organ was now carefully separated from the upper pole of the kidney by blunt dissection, a small arterial branch coming down from the diaphragm was torn, the main artery and two small veins coming from the renal artery and vein, respectively, had to be tied. One has to exercise some care in dissecting the median aspect of the gland, as it lies in close contact with the renal vein. The organ was removed in toto without tearing. There was no bleeding of any account. A cigarette drain was put in the bed of the removed organ and led out through the wound; wound closed down to drain. The operation lasted one hour thirty-five minutes.

The pulse after operation went up to 140 but soon came down to 90–100.

Blood-pressure, which was 85/55 before operation, jumped up to 100/65.

On the third day post-operative blood-pressure was 115/65. Patient in good condition, mentally much brighter. Wound is draining rather profusely.

His convalescence was smooth. Two weeks after operation patient felt very well. He was much brighter and in the last days more alert, took an interest in his surroundings, read the paper and even wrote a postal card to his relatives, which

## EXTIRPATION OF ADRENAL GLAND FOR EPILEPSY

he had not done for years. Has had no convulsion since operation. (On admission to the hospital he had a very severe convulsion on January 31st and February 2nd; another on February 5th; then one slight convulsion on February 11th. In the night of February 12th, just before operation, three severe convulsions.)

*Pathological Report.*—(By Doctor Rohdenberg.) Gross Appearance: Specimen consists of an adrenal gland measuring about 3 x 4 cm. and varying from 2 to 4 mm. in thickness. It is light brown in color and the surface shows a few adhesions. There is no evidence of inflammation.

*Microscopical examination* shows an adrenal gland in which the relative proportion between the cortex and the medulla is disturbed, the medulla being distinctly smaller than usual. The cells of the cortex at the periphery of the gland are markedly vacuolated. About the centre of the cortex the cells are apparently filled with the products of secretion, while in those adjacent to the medulla there is again an area of vacuolization. The medulla itself shows no histological abnormalities. Special lipid stains show a maximum of deposit in a zone two or three layers of cells beneath the capsule and about the central vein. The medulla is practically free of lipid deposit.

Special stain for connective tissue fails to demonstrate abnormality.

By staining the sections in acid fuchsin, followed by Mallory's aniline blue and Soudan 3, there are evident in the zones of the maximum lipoidal content very small, almost black intracellular granules varying from 1 to 25 or 30 to the cell. These granules are scattered at the periphery of the cell and are not in direct relation to the nucleus. The significance of these granules is not known. They do not occur in all parts of the section. Mitochondria are not demonstrable.

March 3: Out of bed, feels very good. March 4-5 (19 days after post-operative): Patient had five convulsions during the night; each convulsion lasted from one-half to one minute. Bit tongue, became cyanosed and moved hands and feet considerably. March 5: Convulsion at 9.45 A.M., lasting one-half minute; pulse very rapid, pupils dilated. March 6: Had one convulsion. March 7: Had two convulsions. March 9: Had five convulsions, bit lip and tongue. March 10: Five convulsions lasting two to four minutes. March 11: Five convulsions, each one appears to be a little more severe. March 12: Had six convulsions, very bad. March 13: Very noisy, refuses to eat. Seven convulsions; first very light,



FIG. 7.—After Alberan.

last two very severe. March 14: Had three convulsions—not severe. Refuses nourishment. March 15: Two light convulsions; takes nourishment well. March 16: Had five very light convulsions between 8.20 and 11.25 P.M. March 17: Had convulsions at 8.40, 9.25, 10, 10.45, 11.25 P.M. March 19: Has not had convulsion for two days. To-day at 8.35, 9.30, 9.35, 10.05, 10.35, 11.10, 1 A.M. March 20: Very light convulsion. March 21: 9.05 P.M. slight convulsion—twitching of muscles of arms and legs, no loss of consciousness. March 22: Convulsion at 8.30 P.M.; very slight. March 24: Convulsion at 8.30, 11.30. March 26: Convulsion at 11.30, twitching of arms and legs and patient screaming. April 10: Has not had any convulsions since March 26th. Discharged from hospital. April 20: Had convulsions lasting four minutes at 8 A.M. Slight twitching of muscles. At 9.15 P.M. slight attack. At 11 P.M. slight convulsion, contraction of abdominal mus-

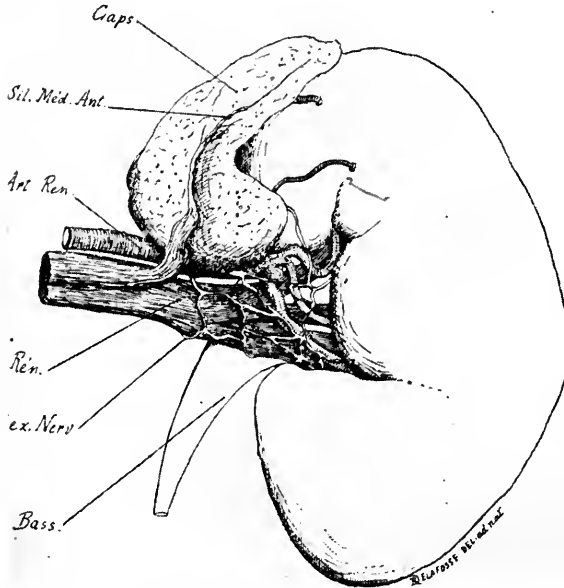


FIG. 8.—After Alberan.

cles. Brother says the attacks are nothing compared to his attacks before the operation. May 7: Brother reports patient is perfectly well. No convulsions. May 15: 2 A.M. attack of labored breathing with a little frothing at the mouth. Duration three minutes. No loss of consciousness. May 17: 11 P.M., similar attack. May 24: Slight twitching of muscles of neck and head drawn to one side. June 7: Three convulsions, light, bites tongue. June 8: One convulsion, light. June 18: Three convulsions, light. June 20: One convulsion, hard, in afternoon. July 4: One convulsion, hard. July 16: Five convulsions, light. July 18: One convulsion, hard. August 4: Three convulsions, light. August 17: One convulsion, light. August 19: One convulsion, light, in afternoon, wet bed. August 20: Five convulsions, light, wets bed. August 31: Six convulsions, light, wets bed. September 1: Five convulsions, light, wets bed. September 2: Two convulsions, light, wets bed. September 3: Four Convulsions, light, wets bed. September 5: Six convulsions, light, wets bed. September 6: Three convulsions, light. September 7: Five convulsions, light. September 8: One convulsion, light. October 28: Feels very good now, no more convulsions since September 8, 1921.

Before the operation this patient had ten to fifteen epileptic attacks every night. The convulsions were so severe that his three brothers had to hold him down to prevent him from falling out of bed.

Although the patient has not been entirely cured, there is noticeable, however, a distinct improvement. The attacks which he had before the operation are now

less in frequency and in intensity. He has intervals of complete freedom from convulsions (March 26 to April 20; September 8 to October 28).

*Surgical Anatomy of the Adrenal Gland.*—The anatomy of the adrenal gland is usually treated rather superficially by the standard text-books of Anatomy.

A very exhaustive study of the anatomy of the organ has been made by J. Alberran and Cathelin.<sup>2</sup>

*Situation.*—It is very rare to find the adrenal gland lying on the top of the upper pole of the kidney as is usually supposed. The adjective "suprarenal" gives, indeed, a wrong impression of the situation of the organ. "Adrenal gland" is the more appropriate term.

In the majority of cases in the human being as well as in all other mammals, the adrenals are placed along the inner border of the kidney, above its pedicle, near the spinal column. On the right side the organ is in close proximity to the vena cava and on the left side it lies close to the aorta. The upper extremity of the gland seldom passes beyond the upper pole of the kidney. (Figs. 1, 2, 3, 4, 5.)

One can distinguish two variations in the situation of the adrenal gland: (a) the low situation, which is very frequent; (b) the high situation, which is encountered only on the right side, where the organ is lodged deeply in the angle of the vena cava and the liver (Fig. 6).

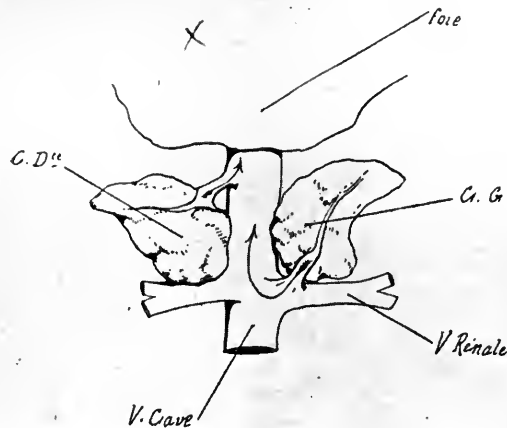


FIG. 9.—After Alberan.

There are always two adrenal glands present, one on either side. The few reports in the anatomical literature of total absence of the adrenal glands must be considered with caution, as for instance the observation of Schet who found the adrenal replaced by an abundant mass of fat.

In some rare cases (Rokitansky, Grawitz, Weiler, Ulrich) the adrenals were found lying beneath the capsula propria of the kidney.

*Accessory adrenal glands* are frequently found on the cadaver, especially in children. These accessory adrenals can have a real importance in medical pathology, Roth having found multiple adrenals in the state of compensatory hypertrophy in a case of Addison's disease. In the surgery of the kidney, accessory adrenals have become of quite some importance since Grawitz discovered that they are frequently the starting point of large pararenal tumors, the so-called hypernephroma.

These accessory adrenal glands are found: (1) below the capsula propria of the kidney, or even in the parenchyma of the kidney itself; (2) in the neighborhood of the adrenals; (3) along the spermatic vessels; (4) within the solar plexus; (5) on the surface of the ovary; (6) in the substance of the testicle. Wherever they are situated, these accessory adrenal bodies are very small, rarely

<sup>2</sup> Revue de Gynecologie et de Chirurgie abdominale, vol. v, 1901, p. 973.

larger than 7-8 millimetres in the largest diameter. They are little, round, and egg-shaped bodies of yellowish color and of soft consistency. Sometimes they are surrounded by a thin capsule which separates them from the surrounding tissues. Only rarely, and then only in the large ones, a reddish portion represents the medullary substance.

Otto describes a case in which both adrenals had been fused together in the form of one organ.

Regeneration of the adrenal glands was first described by Tizzoni and has been observed also by others, although Langlois doubts the possibility of regeneration. However, all observers concur that compensatory hypertrophy does occur on the not-operated side.

The color of the glands varies from a yellowish to a grayish color. In two cases Alberran and Cathelin found them to be light red. Frequently one encounters small yellowish spots of the size of a pin-head, sprinkled over the surface of the organ. These little granules are simple adenomata.

The parenchyma of the gland is usually soft and friable; attempts to sever its connection with the surrounding tissues, if not done very carefully, result in tearing. In the cadaver it feels a little harder and on palpation gives the impression of a lobulated gland.

The right suprarenal capsule is usually a little larger than the left; on the average the organ measures 5 cm. in length by 2 cm. in width. The average weight is 4 grammes with a maximum of 2 grammes.

The form of the adrenal gland is usually given as that of a Phrygian cap. This, however, is only true in the case of the fetal organ. In the adult its form varies greatly. It may be triangular equilateral, elliptical, ovoidal or crescent-shaped. On the whole one can say that its form resembles a large comma, placed in such a fashion that its head points toward the pedicle of the kidney. Very often the two organs vary in shape in the same individual. On one side the gland is triangular and ovoid on the other. One organ may be also smaller than the other one.

*Blood Supply.*—On the anterior surface of the gland one usually finds a small furrow running vertically downward and carrying a large vein. This furrow is often called the hilus of the gland, although it cannot be compared to the hilus of the liver or the kidney, because the main vessels of the gland do not enter here. The adrenal gland has three vascular pedicles corresponding to three arteries.

The superior adrenal artery arises from the superior diaphragmatic artery, the middle adrenal artery from the abdominal aorta, the inferior adrenal artery from the renal artery. This vascular arrangement is subject to slight variations, at least in regard to the two branches. Very often there exists a common trunk, arising from the inferior diaphragmatic artery and giving off two smaller branches, an internal and an external branch.

The middle artery may be missing. On the right side it passes beneath the vena cava and over the right crus of the diaphragm. G. Martin has seen a case in which a large artery coming from the aorta, between the coeliac axis and the superior mesenteric artery, sent two branches to the left kidney and two small ones to the suprarenal capsule.

The inferior artery is often replaced by a branch arising from the renal parenchyma from the superior internal pole (Fig. 7).

By their anastomosis there results a peri-suprarenal arterial network which surrounds the gland.

*Veins.*—There exists one principal vein (central vein of Testut; middle capsular vein or suprarenal vein of Charpy). This is the collecting trunk which carries the larger part of the venous blood of the gland. Its average length is

## EXTIRPATION OF ADRENAL GLAND FOR EPILEPSY

3 millimetres. On the left it emerges from the inferior third of the anterior surface of the gland and on the right side near its internal border. It runs in a small furrow of the gland and is fastened to the organ by thin connective-tissue bands (Fig. 8).

After leaving the gland the left vein takes an oblique direction downward and towards the right to empty itself into the renal vein; the right vein turns upward and to the left to join the vena cava (Fig. 9).

*Lymphatics.*—They were studied by Stilling and Sappey. Stilling in 1887 injected them and thought them to be the excretory ducts of the gland. Sappey found a large lymph-node situated above the renal vein. This lymph-node receives three suprarenal lymph-vessels which communicate with another lymph-node, which also receives lymph from the kidney.

*Nerves.*—The nerve supply of the adrenal glands is very abundant. It forms a rich network derived from the solar and renal sympathetic plexuses. It may be possible that the pneumogastric and phrenic nerves contribute to the nerve supply.

### TECHNIC OF OPERATION FOR REMOVAL OF LEFT ADRENAL GLAND

According to its anatomical situation the left adrenal has been selected by all surgeons who have done this operation. The main reason for this is the better accessibility on this side. On the right side, as stated before, the adrenal is well tucked away in a niche formed by the liver and the vena cava. Although there is unanimity on this point, surgeons differ as to the best approach. Two ways have been selected: the transperitoneal abdominal method and the extraperitoneal lumbar incision.

Brüning has used the transperitoneal route. He uses an incision somewhat S-shaped. Incision in median line from ensiform process 10 cm. downward; from here the incision curves outward, cutting transversely through the right rectus; from the outer border of the rectus muscle it turns downward for a few cm. following the direction of the fibres of the obliquus externus.

The peritoneum is opened and omentum and intestines pushed aside and held out of the way by abdominal sponges. The stomach must be pushed upward and to the right, the colon transversum downward and secured in this position by the hands of assistants. Now the tail of the pancreas can be seen through the layers of peritoneum. Just a little above the tail of the pancreas the splenic vessels can be identified running towards the hilus of the spleen.

Below the pancreas the peritoneum is incised. Hereby the splenic flexure of the colon is made movable and can be pushed downward. The pancreas is held out of the way above by blunt retractors and in order to do this sufficiently it must be properly isolated up close to the kidney. By this manoeuvre a retroperitoneal space is made visible bounded mesially by the aorta, laterally by the upper pole of the kidney, below by the pedicle of the kidney. This space is occupied by the adrenal gland. The organ is covered by a sort of a fascia which is formed by solid fat tissue. Here are also found the arteries, the most important of which is a branch arising from the aorta. These should be tied. The small diaphragmatic branches need no ligature. After ligating the vessels the organ can be removed by careful dissection

with forceps and scissors. After removal of the adrenal gland its fat capsule is closed by a few catgut stitches and the posterior layer of the peritoneum is sewed up.

Brüning advises to use long-handled instruments on account of the great depth of the operating field, *but even then the operation is very difficult.*

Shortly after Brüning's publication, Bumke and Küttner advocated the lumbar approach with resection of twelfth rib. The incision is practically the same as used for extirpation of the kidney (Bergmann-Israel incision).

In my experience the operation has proved to be simple, not any more difficult than an uncomplicated nephrectomy. It has great advantages over the transperitoneal route which is very difficult and complicated. In the transperitoneal route of Brüning, if drainage is necessary, we have to drain through the general peritoneal cavity. This alone complicates matters materially.

In my opinion the lumbar route is the procedure of choice in removal of the adrenal gland.

#### CASE REPORTS

Brüning: Ztbl. f. Ch. No. 43, 1920, p. 1314. E. S., nine years old. Daily many attacks of amnesia, no convulsions.

Operation, May 4, 1920. Immediate disappearance of attacks of amnesia. These, however, recurred after some time, although less frequently. In this case only one-half of the left adrenal had been removed.

H. Sp., age twenty-one years. Several attacks of convulsions daily.

Operation, April 11, 1920. *Since that time no more convulsions.*

H. M., age eighteen years. Daily convulsions.

Operation, June 18, 1920. *No attack since operation.*

H. S., age thirty-eight years. Several attacks of convulsions and amnesia daily.

Operation, July 12, 1920. The attacks of amnesia have recurred, also had one convulsion. Formerly all internal medication had been futile, now Sedobrol and small doses of Luminal 0.1 two, three times a week suffice to suppress attacks.

M. B., age seventeen years. Severe epilepsy, patient somewhat idiotic. In spite of daily administration of Luminal, ten attacks of convulsions a day.

Operation, July 2, 1920. Since the operation off and on short attacks without loss of consciousness, which can be entirely suppressed by Sedobrol.

H. B., age thirteen years. Old encephalitis with several foci, convulsions with frequent attacks of amnesia.

Operation, July 20, 1920. Attacks after operation less frequent and less intense; can be easily influenced by administration of Sedobrol.

C. F., age fifty-two years. At intervals of four to five weeks attacks of convulsions during several days.

Operation, July 21, 1920. No attack since operation. Time since operation not long enough to judge result.

F. H., age seventeen years. Several attacks daily with attacks of amnesia.

Operation, July 22, 1920. Convulsions have ceased, attacks of amnesia still present.

J. N., age sixteen years. Several attacks of convulsions with attacks of amnesia. Internal medical treatment without success.



## EXTIRPATION OF ADRENAL GLAND FOR EPILEPSY

Operation, July 26, 1920. After operation, short, fleeting convulsions without loss of consciousness, easily suppressed by Sedobrol administration.

Brüning used in all cases his transperitoneal route.

Peiper reports that in Schneider's Klinik in Frankfurt seven cases were operated upon. In every case the immediate effect of the operation was most striking. All the cases were free from convulsions after the operation. However, this happy state of affairs did not last very long; sometimes after a longer and sometimes after a shorter interval the convulsions reappeared in their old severity. Therefore the operation has been discarded in the Frankfurt Klinik.

C. Steinthal operated upon 7 cases—5 male and 2 female. The male patients were 15, 16, 17, 18 and 23, respectively, and the female patients 19 and 29. In one male patient the convulsions started one and one-half years after a head trauma; all the others were cases of genuine epilepsy. All patients were severe epileptics who had undergone careful institutional treatment for a long time without benefit. Method of operation: Lumbar retroperitoneal route. In none of the cases was a complete cure effected.

W. L., age eighteen years. Epileptic since age of four months. In 1920, 101 attacks of convulsion, 30 attacks of dizziness in 1921; three to four attacks a day.

Operation, February 10, 1921. On the ninth and sixteenth days after operation fifteenth day post-operative, then a few slight attacks. March 10, 1921, three attacks.

Discharged March 19, 1921. Adrenal was removed in several pieces; it is possible that a small amount was left.

F. F., age seventeen years. Epileptic since one and one-half years, one year after head injury.

Operation, February 10, 1921. On the ninth and sixteenth days after operation at night, slight clonic contractions without loss of consciousness. March 3, 1921, typical, not very severe nocturnal attack.

Discharged March 10th in good condition.

Lu. L., age fifteen years. Epileptic since one and one-half years without external cause.

Operation, February 14, 1921. After operation no more attacks, but receives regular doses of Luminal. After the removal of the adrenal, severe venous hemorrhage in consequence of slipping of a ligature. In the attempt to control the bleeding the renal vein was injured and had to be tied. Kidney became necrotic, had to be removed subsequently.

M. H., age nineteen years. Epileptic for fifteen years. Rarely a day passes without attacks. Mostly attacks of dizziness. January, 1921, two attacks of convulsions and sixty-eight attacks of dizziness.

Operation, February 21, 1921. The next day after operation two attacks of convulsions, in the course of convalescence twenty-seven attacks of convulsions and seven attacks of dizziness.

F. O., age twenty-nine years. Attacks since eight years. From August, 1920, to February 15, 1921, sixty-six convulsions. And 130 attacks of dizziness.

Operation: February 23, 1921. On the 2nd day and 5th day after operation one attack of dizziness, since operation 11 spells of dizziness and one attack of convulsions. Discharged on March 19, 1921, in good general condition.

A. G., age sixteen years. Epileptic for four years. In 1920, fifty-eight attacks. In January, 1921, four spells, first half of February nine convulsions and four spells of dizziness.

Operation, February 21, 1921. No more attacks after operation during his stay in the hospital. Discharged March 10, 1921. As soon as he came back to the Home for Epileptics he had one attack.

A. W., age twenty-three years. Epileptic since his seventh year. Attacks occur at nights. January, 1921, four convulsions and one dizzy spell. Beginning of February, 1921, eight convulsions and one dizzy spell.

Operation, March 3, 1921. Eleven days after operation the first attack of convulsions, which was repeated on the twelfth and thirteenth days.

From these operative results Steinthal concludes that extirpation of the adrenal cannot be considered a cure of epilepsy.

Sandor, St. Four cases of very severe type. After twelve days—four weeks no recurrence of attacks in all four cases. Time of observation too short to draw conclusions.

Seiffert reports one case of idiopathic epilepsy in which he removed the left adrenal capsule according to Brüning's method. Girl, twenty-two years old, since her sixteenth year, epileptic convulsions with each menstrual period. In contradistinction to the other cases thus far operated upon for this condition, a pathologically altered gland was found. It was the seat of cyst of the size of a hen's egg. The fluid of the cyst was of the color of red lacquer. After operation no feeling of numbness and feeling of oppression in head, epileptic attacks shorter in duration, less in frequency. Twice menses without convulsions.

## THE SURGICAL VALUE OF THE ESTIMATION OF THE BILE PIGMENTATION (ICTERUS INDEX) OF THE BLOOD SERUM\*

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THE need has long been felt for a simple and practical method of estimating accurately the actual degree of icterus existing at a given time. That this could best be done by studies of the blood was a most obvious conclusion. If such a method of blood examination—one that could readily be applied as a routine in the ordinary laboratory—could be found, it would surely prove to be a clinical procedure of considerable usefulness. Very often in early cases of suspected biliary or hepatic disease there is doubt as to whether or not an actual jaundice is present, and the questionable adjective, "subicteric," has been adopted to describe such cases. This term is frequently improperly used and a patient is credited with showing an incipient jaundice when his normal complexion, some other pigmentation, Addison's disease, or merely an anæmic sallowness is responsible for the hue of his skin or sclera. In these cases the usual bile tests for the urine are equally inconclusive. In marked jaundice the inspection of the skin and sclera from day to day, or even from week to week, gives very little information as to its intensity or whether there is a progression or recession of the icterus. One's opinion as to the existence of jaundice in doubtful cases and as to its depth or lightness in advanced cases is greatly influenced by the character of the illumination, and the question of variation from time to time hinges entirely upon the rather uncertain equation of the observer's memory of his retinal impressions. In outspoken icterus the examination of the urine, which, in addition, may vary in concentration, gives very little more assistance in solving these questions.

It appeared, further, that it might be of interest to verify the claim that has been made that the blood showed changes in the bile content, as represented by its pigment, bilirubin, actually before these could be observed elsewhere. It is well known that in certain forms of pernicious anæmia, namely in so-called hæmolytic or acholuric jaundice, a bile discoloration of the skin and sclera appears without bilirubinuria. In these cases bilirubin is found in the blood, seemingly fixed in the plasma. It has also been stated that, in general, bilirubin is only excreted in the urine after a certain point of concentration has been reached in the blood. It has further been asserted that bilirubin may be demonstrated in the blood not only before it is excreted in the urine, but even before it has pigmented the skin or sclera.

Although the surgical literature is strangely devoid of any reference to the subject, the idea of measuring the bilirubin content of the blood is not entirely new. Several attempts have previously been made without, however, much

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practical result. In 1903 Gilbert, Herscher and Posternak reported on a method of measuring the bilirubin in the serum by an adaptation of the Gmelin-Hayem reaction. Their method is a very complicated, inexact and impracticable one and apparently has never been generally adopted, although it has been modified and used by Scheel and Sunde. Posselt, in 1907, advocating the inspection of the serum in capillary tubes for bile staining as an aid to the early diagnosis of icterus, suggested a comparison of these tubes with a test solution of bilirubin in artificial serum in tubes of equal character as a means of estimating the degree of bilirubinæmia. He gave no data and apparently did not put his suggestion to a practical test. In 1913 Hymans van der Bergh and his co-workers described a method based upon Pröscher's reaction on bilirubin with Ehrlich's diazo reagent, the reaction on the serum being compared to the reaction on known bilirubin solutions. This method is the one that has been most popular and has been advocated by Feigl and Querner, Botzian and others, but most recently and enthusiastically by Lepehne. The method is indirect, quite involved and protracted, has many possible inaccuracies and does not lend itself well to routine laboratory use. Hooper and Whipple, in 1916, described a colorimetric method of determining the amount of bilirubin in the blood in which they tested the bluish-green, acidified bilirubin serum against a standard wedge containing a standardized copper sulphate mixture. This method is in reality a modification of the Hammarsten reaction and does not seem to have found favor. In the same year Hoover and Blankenhorn, in a study of "dissociated jaundice," used Gmelin's test for qualitative examination, but discarded it as not sufficiently delicate for a quantitative estimation of the bilirubinæmia. They accept the principle that the color of the serum is the best guide for this purpose, but used only the very crude method of calculating the proportion of plasma required to give a visible tinge to a 1 cm. column of water.

Inasmuch as none of these previously attempted quantitative methods had proved entirely satisfactory, nor had any been put to general practical use, I took up the matter with our chemist at the Lenox Hill Hospital, Dr. Adolph Bernhard, suggesting preferably a direct colorimetric examination of the blood. Acting upon this suggestion, Doctor Bernhard and Dr. A. Peter Maue began working on the problem. In the meanwhile Meulengracht, of Copenhagen, reported on a direct colorimetric method of testing the color of 1 c.c. of plasma of citrated blood against a standard yellow color, using a 1 to 10,000 solution of potassium bichromate as the approximate normal shade and depth for the purpose. This was done in test-tubes of equal diameter, and the number of times the plasma required dilution with normal saline until it corresponded to the standard color was the figure giving the degree of icterus. He subsequently improved his method by utilizing an apparatus resembling the Sahli hæmoglobinometer. Meulengracht's method is based upon the assumption that bilirubin is practically the only yellow pigment appearing in the blood in appreciable quantities and that any other yellow pigment that may occur in the blood does so in negligible traces. Practically

the only exception to this premise is the occasional occurrence of a lipochrome pigment similar to the lutēin or carotin present in the blood of cows, etc., and derived from their food. This extraneous pigmentation of the blood in the human is supposed to follow a diet of certain vegetable foods, such as carrots, and is therefore said to be found especially in diabetics. Although this point has not been definitely proven, it does seem to constitute an element of error, which, however, can be taken into consideration and which under ordinary nutritional conditions plays no rôle.

Bernhard and Maue found that better results could be obtained by using the blood serum instead of the plasma and further modified Meulengracht's method by using a Duboscq colorimeter, which gave much more accurate and definite results. Their method seems to present the least possibility of error and has the further advantage of extreme simplicity. The centrifuged serum from 5 to 10 c.c. of blood is used. The standard 1 to 10,000 potassium bichromate solution is set at 15 or 20 mm. in the colorimeter and the icterus index is obtained by dividing the reading of the standard by the reading of the unknown serum. Should the color of the serum be too intense to compare with the standard solution, it is diluted with normal saline until its color is nearer that of the standard. When a dilution is made, the resultant figure from the division of the reading of the standard by the reading of the unknown must be multiplied by the dilution figure to obtain the index.

A large number of apparently non-jaundiced, apparently jaundiced and of definitely jaundiced patients have been examined. In 161 individuals without clinical evidence of icterus the figures have ranged from 1.6 in a case of fractured skull (male, age forty-two, No. 4183-'21) to 13.5 in a case of subacute cholecystitis without jaundice (female, age twenty-two, No. 1970-'22). In 144 cases the readings varied between 2.5 and 5, with 3.6 established as the average normal value. These figures probably represent a normal bilirubinæmia which is more or less generally conceded to exist. No case with clinically recognizable icterus went below 14, so that approximately 8 to 14 would be threshold figures. The lowest actual figure with definite though slight icterus was 14.4 in a patient (male, age forty-two, No. P. 1401-'22) with a mild post-operative jaundice after appendectomy and from this point the figures have risen to 210 in a case of extreme icterus (male, age forty-seven, No. 7368-'21). It must be understood that these figures do not represent the actual quantity of bilirubin in the blood, but merely the intensity of the staining of the serum as compared to the color of an arbitrary standard.

As to the practical surgical application of the test, this may be divided into the following headings:

1. *In Differential Diagnosis.* A. *In Suspected Icterus.* The test will eliminate as icteric other discolorations that suggest icterus, as, for example:

Male, age forty (No. P. 828-'22), had been operated on two days previously for an acute gangrenous appendicitis and was seen for the first time in good daylight. His skin and sclera had a distinct so-called subicteric hue and a post-

operative jaundice was suspected. Although the patient assured me that this was his normal complexion, I had his blood tested. The index of 5 showed that the patient's opinion was correct.

In a case of pernicious anemia (male, age forty-nine, No. 3656-'21) in which the patient had a distinct yellowish hue, suggestive of icterus, the icterus index was well within normal limits (3.5) although another patient with this disease (female, age fifty-five, No. 3757-'21), also distinctly icteric in appearance but with no bile in the urine, had an index of 12. Two other patients with pernicious anemia (female, age fifty-two, No. 1271-'22 and female, age forty-seven, No. 1942-'22), both subicteric, had icterus indices a trifle above normal, namely, 7.5 and 7.8 respectively. Neither case showed bile or urobilin in the urine.

One of the medical services at the hospital is trying out acroflavine, administered intravenously, in the treatment of various forms of infection. Some of the patients who have received this dye simulate icterus after twenty-four hours. At first it was not quite certain that they were not icteric, but numerous index determinations helped to eliminate the doubt, as the dye apparently only stains the tissues, does not remain in the blood except for a very brief period after the injection, and consequently has no influence on the icterus index after a few hours have elapsed. The following examples will demonstrate:

Female, age twenty (No. 1519-'22), who had received an intravenous injection of acroflavine solution for the treatment of a septic endocarditis, showed a marked yellowish discoloration of the skin the day after the injection. The urine was deep orange and gave a yellow foam. Although it was suspected that this discoloration was an acroflavine staining, the possibility of some hepatic destruction with jaundice, as is occasionally seen after salvarsan administration, was considered. A normal icterus index of 5 definitely settled the question, excluding the jaundice possibility.

Male, age twenty-nine (No. 2106-'22), was admitted to the hospital with abdominal symptoms and the diagnosis of a high acute appendicitis or an acute cholecystitis. Examination revealed a definite consolidation of the lower lobe of the right lung and the patient was given an injection of acroflavine. The next day he appeared to be markedly icteric. His urine was dark orange and gave a yellow foam, although negative chemically for bile. It was appreciated that this yellow staining of the skin and urine was probably due to the acroflavine, but it was felt that possibly the patient might have a gall-bladder condition after all. His icterus index of 5.2 showed that the coloration of the skin and urine was not due to jaundice.

The following case is of more than usual interest:

Male, age twenty-three (member of house staff), gave the impression of being slightly jaundiced during a six months' period of observation. He stated that to the best of his recollection he had always had this subicteric hue which was at some times more marked than at others, although he has always been in good health. His icterus index was 16, due probably to a rather more than normal bilirubinemia, or as van der Bergh has designated the condition, a "physiological constitutional hyperbilirubinemia."

For the sake of completeness it might here be mentioned that the icterus index determination will assist in the diagnosis of jaundice and in the study

of its progress in patients belonging to the dark-skinned races such as Negroes, Mongols, Hindus, etc.

*B. In Latent Icterus.*—As the test is one of extreme delicacy, it will indicate incipient or threatened jaundice, so-called "latent" icterus, before other evidence of this condition can be noted by the ordinary clinical signs. The following examples may be cited:

Male, age twenty-one (No. 3229-'21), was under observation for a suspected lesion in the stomach or duodenum. Although there was no jaundice, the icterus index of 9 called attention to the biliary system. At operation a definite chronic cholecystitis was found, the stomach and duodenum being entirely free from disease.

Male, age fifty-two (No. 6409-'21), with a carcinoma of the colon without clinical signs of jaundice or bile in the urine, was examined. An icterus index of 12 aroused suspicions of some hepatic involvement and laparotomy revealed extensive liver metastases. After operation the patient showed evident jaundice with bile in the urine and an icterus index of 56.

Male, age thirty-nine (No. 6165-'21), with no clinical jaundice and an icterus index of 8, was operated on for a doubtful abdominal condition. Owing to the rather higher than normal figure the gall-bladder region was explored and adhesions between the gall-bladder and duodenum were discovered with some distortion of the bile ducts. These adhesions were released and the icterus index after operation dropped to normal (4.2).

Female, age twenty-two (No. 1970-'22), gave a definite history of gall-stones with repeated attacks of colic and the passage of stones in the stool. She was admitted to the hospital without a trace, clinically, of icterus, but her index was 13.5. Operation disclosed marked omental adhesions to the gall-bladder, which was a typical strawberry organ, although no calculus was found. Eight days after cholecystectomy the icterus index had fallen to 3.7.

The possibilities in this direction are multiple. In doubtful colic, for instance, a high icterus index could be interpreted to indicate biliary origin as against a kidney lesion. The icterus index determination might help to differentiate an acute cholecystitis from a high appendicitis or a perforated gastric or duodenal ulcer, or chronic gall-bladder disease from ulceration or malignancy at or near the pylorus if there is no secondary involvement of the liver or bile tracts. In any doubtful case of right upper quadrant disease a high index would tend to indicate biliary or hepatic involvement as slight interference with the normal flow of bile seems to show color changes in the blood some time before this can be recognized in other ways, although naturally a low index would not necessarily exclude such a condition.

*C. In Marked Icterus.*—As yet a study of the initial figures in the various cases of jaundice examined does not seem to give much diagnostic information. The index in simple catarrhal jaundice or cholecystitis may be very high (female, private case of Doctor Rohdenburg, acute catarrhal jaundice, icterus index 128.2; male, age twenty-seven, No. 7368-'21, subacute cholecystitis and hepatitis, icterus index 210) while in calculous or carcinomatous obstruction it may be comparatively low (male, age forty-six, No. 3239-'21, impacted common duct stone, icterus index 56; male, age fifty-nine, No. 7172-'21, adenocarcinoma of liver, chronic pancreatitis with metastatic adenocarcinoma

of pancreas, icterus index 75; male, age fifty-nine, No. 7716-'21, carcinoma of head of pancreas, icterus index 75). This corresponds to the observation, made by the usual clinical methods, that the intensity of the icterus is no measure of the character, severity or permanency of the disease. If, however, the fluctuations in the index figures are noted some light may be thrown on the diagnosis.

A recession or remission in the index figures during an observation period, even without other clinical evidence, would, of course, suggest a movable obstruction due to inflammatory products or stone as against the naturally increasing index of a progressive occlusion due to carcinoma. It must be emphasized, however, that the converse of this proposition does not hold, for, as will later be shown, increasing figures may occur with an inflammatory obliteration of the common duct (female, age fifty-three, No. 4440-'21) or with a calculus tightly impacted in the papilla (female, age fifty, No. 6771-'21).

In catarrhal cases the index tends to fall rather rapidly often before a clinical change can be observed. Several such instances have been noted, but the following three are the most striking:

Female, age ten (No. 6975-'21), had a marked jaundice and an index which had risen to 100 on December 17, 1921. With no appreciable change in the coloration of the skin or eyes, the index on January 14, 1922, had fallen to 63. Shortly before this latter test the patient was examined by a surgeon, who advised operation for common duct obstruction. The operation, however, was not performed and from this point the jaundice, evidently a catarrhal form, rapidly cleared up.

Male, age forty-seven (No. 7368-'21), with intense jaundice, was examined, and showed an icterus index of 210. Several days later the blood was reexamined, and although there was no noticeable change, clinically, in the patient's appearance, the index had fallen to 75. In spite of this an exploratory laparotomy was done. Operation disclosed a distended and somewhat thickened gall-bladder, but no signs either of tumor or calculi. The liver was slightly enlarged and congested. The gall-bladder was easily emptied by compression and it was not removed. The patient made an uneventful recovery, but operation might have been avoided, had the significance of the rapid fall in the index figures been understood.

Male, age thirty-two (No. 944-'22), was admitted to the hospital with a diagnosis of either a catarrhal jaundice or a salvarsan hepatitis. He had a moderate jaundice and an enlarged liver. His icterus index rose from 115 on February 8, 1922, to 124 on February 18th, and only the merest trace of bile could be obtained from the duodenum by the Lyon's test. Following a course of "medical drainage" of the gall-bladder by means of the duodenal tube and magnesium sulphate instillations, the index dropped rapidly to 62.5 on February 24th, without much apparent change in the depth of the jaundice and with only a slight increase in flow of bile into the duodenum. On March 8th the index had fallen to 26, and coincident with this latter decline, the icterus cleared up except for a slight scleral pigmentation, the enlargement of the liver receded and the bile flow into the duodenum approached normal.

In pure obstructive jaundice, *i.e.*, jaundice due to occlusion of the hepatic or common duct, the rise in the icterus index seems much more definite and



rapid than in cirrhosis, hepatitis, metastatic carcinoma or other forms of hepatic destruction, especially of the chronic variety, as for example:

Male, age twenty-three (No. 3205-'21), had received several salvarsan injections and became deeply jaundiced. The index was 107 and remained around that figure over a period of four weeks' observation. As the patient failed to improve and there were only traces of bile in the duodenum, an exploratory laparotomy was performed. A somewhat congested liver was found with a contracted gall-bladder, no calculi and no evidence of obstruction of the common duct. A bougie was easily passed into the duodenum. After operation the patient's condition remained practically stationary and his icterus index fluctuated, during a two months' period, between 100 and 114. He finally left the hospital unimproved, with the probable diagnosis of hepatitis due to salvarsan.

Male, age fifty-one (Dispensary No. 319-'21), was under observation for a probable hypertrophic cirrhosis or carcinoma of the liver. He was quite jaundiced and his index was 70. Four months later his condition was not much changed and his index was 71.

2. *In the Placing of Operative Indications.*—The test appears to be of considerable value in determining whether an icterus is progressing or receding, and how rapidly this is occurring, and in helping the surgeon to decide when and if operative interference is indicated in obstructive jaundice. In this connection we have used the test in conjunction with the duodenal tube and the instillation of magnesium sulphate to help estimate the completeness of the obstruction.

Let us assume that a definite diagnosis of common duct obstruction due to calculus or other cause has been made. There is marked jaundice and a high icterus index. After several days, although there is no visible change in color of the skin or sclera or in the character of the urine, the icterus index has dropped say 30 points. The inference that the icterus is subsiding and that the calculus has been passed or has moved, or that the obstruction is at least partially relieved is justified, especially if bile can be obtained from the duodenum by the tube. This permits the surgeon to wait for a more favorable time for operation, either until the patient is less icteric or even entirely free of icterus, instead of being forced to operate under the various disadvantages that an intense icterus entails. Sometimes operation may even be entirely avoided. To illustrate this hypothesis, I need but to cite two of the cases referred to above, the case of catarrhal jaundice (female, age ten, No. 6975-'21) which barely escaped operation and the case of non-obstructive, subacute cholecystitis and hepatitis (male, age forty-seven, No. 7368-'21) which was operated upon.

As a contrast to the above situation, if it is found that the index is rising rapidly and that definite obstruction exists, operation may be undertaken often before the patient's condition becomes too critical.

Female, age fifty-three (No. 4440-'21), with marked jaundice, gave a history suggestive of cholelithiasis with common duct obstruction. The first figure was 125, which rose to 150 during the week, in which an attempt was being made to prepare her for operation by trying to shorten her coagulation time. At operation an inflammatory obliteration of the common duct was found.

A similar case was a female, age fifty (No. 6771-'21), with a deep icterus of some duration and a history of gall-stones, who gave an initial icterus index of 92. The patient was under observation a few days and given general stimulant treatment, when a subsequent test was made and the index had risen to 120. It was clear that the obstruction was total and progressive, which facts were verified by the duodenal tube. Operation disclosed a large, tightly impacted calculus in the papilla.

When the index remains more or less stationary, one should be cautious in advocating operation. This levelness of the icterus index curve, as has been pointed out above, seems much more likely to occur in chronic non-surgical diseases of the liver, such as cirrhosis, metastatic carcinoma and various other chronic hepatic inflammations and degenerations (male, age twenty-three, No. 3205-'21, salvarsan hepatitis).

3. *In Prognosis.*—In the prognosis of jaundice cases the initial index figures are obviously of as little assistance as they are in diagnosis. Some of the patients with the highest figures have recovered and some with the lowest have died either after operation or without surgical intervention, depending upon the nature of the disease. A study, however, of the variations in the icterus index is here, too, of considerable value and gives definite prognostic information, as illustrated by the following cases:

Female, age twenty-nine (No. 6138-'21), with a severe toxæmia of pregnancy and intense jaundice, was admitted to the hospital on October 12, 1921. The icterus index on the day after admission was 187. Leucin and tyrosin crystals were found in the urine, which also gave a marked bile reaction. On October 21st the index dropped to 62, jaundice still being very marked. The patient now began to show signs of improvement and from this point on made a rapid recovery. On October 25th the index was 31, the color of the skin somewhat lighter, but bile still present in the urine. On October 31st the index was 23 and on November 11th it was as low as 14. It should be emphasized that between October 13th, when the index was 187, and October 21st, when it had decreased to 62, no noticeable change could be detected in the color of the skin or sclera. Although it was realized that these forms of intoxication in pregnancy with marked hepatic involvement are usually fatal, the definite and rapid descent of the icterus index, in spite of the absence, in the beginning, of clinical signs of improvement, indicated that the recovery which eventually occurred would ensue.

An opposite picture with an ascending scale follows:

Female, age twenty-two (No. 5883-'21), developed an acute yellow atrophy of the liver after an injection of salvarsan. The patient was markedly jaundiced and bile, leucin and tyrosin were found in the urine. The icterus index rose steadily and rapidly until one day before death the figure was 210.

In post-operative prognosis the test may prove of service. If the index drops promptly after operation one may assume that the biliary obstruction has been relieved, that the jaundice is subsiding and that the patient is making a satisfactory recovery, even if this is not apparent clinically. An example of this nature is the following:

## ESTIMATING BILE IN BLOOD

Male, age forty-six (No. 3239-'21), presented a history of an intermittent common duct obstruction. When first seen he was moderately jaundiced and had an icterus index of 56. At operation I found a large solitary stone impacted in the choledochus at the junction of the cystic and hepatic ducts. The stone was removed, the shrunken gall-bladder extirpated, and the hepatic duct drained. Although no change could be noted in the patient's color, a few days after operation the index had fallen to 24, and the patient went on to an uneventful convalescence.

If the index rises or remains stationary after operation the assumption that conditions are not satisfactory would be justified, that, for instance, intrahepatic or hilus obstruction from cirrhosis or neoplasm still exists, in spite of duct or gall-bladder drainage outward or by cholecystenterostomy. The test may serve, too, as a rather reliable guide in the after-treatment of an operative case. Take, for example, a case of common duct stone with hepatic drainage, in which the index is not falling properly or even rising. There may be a fair amount of biliary drainage through the drainage tube, no change may be noted in the patient's appearance but the index curve would indicate some imperfection in the drainage system which could be corrected. Should a choledocholithotomy with subsequent suture of the duct and without hepatic drainage have been performed, the fall or rise of the index figures would be most informative in connection with the post-operative prognosis and treatment. Accidental ligation of the hepatic or common duct during cholecystectomy, secondary stenosis of these structures, or the retention of a calculus in the common duct and its impaction at the papilla would all be indicated by a sharp and progressive rise in the icterus index, if there is no biliary fistula. This behavior of the index would be of great assistance in helping the surgeon decide on the question of reoperation and would influence him long before a decision could be reached by his observation merely of the patient's clinical manifestations.

### CONCLUSIONS

In conclusion it may be stated that the icterus index determination is of value from the surgical standpoint:

1. As an indicator of the absence or presence of jaundice and as an aid to diagnosis in doubtful cases, being more dependable and delicate than the inspection of the skin and sclera, or the examination of the urine.
2. As a method of accurately estimating, in frank icterus, the pre- or post-operative increase or decrease in the degree of jaundice with the accompanying progression or recession of the disease.
3. As a guide in differential diagnosis, in the placing of operative indications and in prognosis, in cases of outspoken jaundice, by means of the study of the fluctuations in the index figures.

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# THE SURGICAL TREATMENT OF CHOLELITHIASIS, CHOLECYSTECTOMY AND CHOLEDOCHOTOMY

CONTINUOUS OUT-DOOR TREATMENT

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OF BUENOS AIRES

SOME eight years ago<sup>1</sup> I invited attention to this subject—"After considerable experience in biliary surgery I have been forced to the conclusion that nothing short of cholecystectomy affects permanent cure in the great majority of cases commonly known as attacks of gall-stones," and this statement was, at the time, made in face of the fact that in Keen's Surgery a well-known collaborator asserted, "the danger of re-formation of gall-stones after cholecystostomy is exceedingly small." Since my original essay was published, I have had ample opportunity for clinical reflection, and feel that the more I see of this malady the more convinced am I that the opinion therein expressed was correct.

The direct object of this communication is to present a method of cholecystectomy and of choledochotomy which is simple in execution, which admits of operative rapidity<sup>8</sup> in a zone in which indefinite manipulation is likely to cause shock, which reduces hemorrhage to a minimum, and which from start to finish permits of one being able to see what one is doing.

Ether by the open method is administered, patient placed in the Robson position, and alcohol mercurial<sup>2</sup> skin disinfection completed.

A five-inch incision is made in the right semilunar line. After opening the abdomen, some moments are devoted to careful examination of the local condition, which includes deliberate palpation of the common and hepatic ducts between the right thumb and right index finger inserted into the foramen of Winslow.

The affected zone is then isolated by towels and bibules, every visible nook and corner is meticulously packed so as to obviate any subsequent contamination of the general cavity.

Two large retractors, embracing the whole parietal wall, held by assistants on opposite sides, expose the operative field.

The summit of gall-bladder is seized by two strong pressure forceps, about one inch apart, which are respectively handed to the assistants who make gentle opposing downward and forward traction while the peritoneal line of adhesion of gall-bladder to liver is lightly incised by a sharp scalpel.

A bibule rolled up to about size of finger is then brought into action, by a gentle rolling process with this gauze cylinder the vesicle, in a few moments, is liberated from the fossa fellæ—without any hepatic laceration, and with comparatively trivial loss of blood—if any tough strands of tissue

resist bibule persuasion, they are snipped through with scissors, and complete separation by the "roller" is effected right down to the level of the cystic duct.

As I consider this detail (which is the more feasible the more the gall-bladder is distended) a winning stroke in the operation, I do not hesitate to interpolate that I do not know of any infected internal organ which may be so easily enticed from its habitat—without traumatism and without hemorrhage—as a tense infected gall-bladder can be coaxed out of its hepatic bed by the judicious use of a roll of dry gauze.

An inspection is, at this juncture, made of the peritoneal packing and supplemented, if necessary, by additional sponges.

With a kidney basin in position the portion of the gall-bladder, grasped previously between forceps, is freely opened and contents evacuated.

With a few more touches of scalpel this incision is immediately extended, above and below, to within half an inch of the orifice of the cystic duct, the two deep angles of the incision are then seized by forceps, and the divided cystic artery ligated.

The four forceps, *viz.*, the two originally applied to the fundus, and the two just attached to the deep angles of wound, are grasped in the palm of the left hand, and, with the tip of left index finger fixed in the remaining cystic pelvis, outward tension is made while the right fingers make a final palpation of the ducts.

If a calculus is encountered in the cystic duct it is usually coaxed out by finger pressure through the cystic orifice; failing this, more forcible methods are adopted.

Whenever a gall-stone is found in the common duct, the assistant on the right takes hold of the four forceps, making gentle outward traction on the split gall-bladder, the operator walks round to the opposite side of table (left side of patient) and passes his left index finger into the foramen of Winslow, when the calculus is definitely located it is pushed forward and firmly secured *in situ* by forward pressure of this left finger while the knife in the right hand makes a suitable incision directly over the bulging calculus. When the concretion is removed, a methodical search is made for others, and if any are found, they are kneaded out between the fingers through the same opening.

I do not know of any instance in surgery in which a temporary change of position, on the part of the operator, is attended with more helpful results than the change from right to left in this procedure—the left index finger supinated and slightly flexed behind the duct transforms a deep and dangerous operation into a superficial and simple one.\*

Position is then resumed on the right side of the patient, taking hold of the four master forceps, and replacing the tip of the left index finger in

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\*I have abandoned the use of sutures to close the wound in the common duct; it generally closes spontaneously within fourteen days, and in these cases a few days drainage is beneficial.

cystic pelvis, while an assistant applies a ligature around cystic duct just below the tip of the operator's finger and the two flaps of gall-bladder are then excised. Catgut is used in presence of mucus or pus, otherwise I prefer silk for this purpose.

In case the common duct has not been opened, if there is the slightest suspicion of cholangitis or toxæmia the two large flaps of gall-bladder are snipped away by a curved scissors close to cystic orifice, bleeding vessels secured and no ligature is applied around the duct, which now serves as a useful drain pipe.

Thorough inspection is then made of "the pit"—if dry the parietal wound is closed by through-and-through sutures—if oozing is visible temporary packing is resorted to, followed by the insertion of one end of a wisp (twenty strands doubled and tied at ends) of silkworm gut into the depth of wound—the other end is extruded through the upper angle of the parietal opening. (Occasionally it may be necessary to retain the gauze pack *in situ* for forty-eight hours.)

Whenever mucus or pus is met with, drainage is invariably adopted<sup>3</sup>—preferably with silkworm gut.

My experience dictates closure of all abdominal wounds above the umbilicus by through-and-through strong silk or double silkworm gut stitches and below by absorbable tier sutures. In the former removal of sutures is begun on the tenth day and concluded on the thirteenth—the day before abdominal cases are allowed to sit up.

If there is any indication of shock, a pint of champagne is run into rectum<sup>4</sup> before the patient leaves the operating table. When in bed the electric heating cage is applied, subcutaneous serum drip started, hypodermic injection of digitalin and strychnine given every six hours with an occasional injection of pituitary extract, and as much iced champagne, brandy and water, or citrate water as the patient wishes to sip; nutrient and saline rectal injections are given, alternately, every three hours.

Since 1905 all grave septic cases under my care in hospital have been transferred as soon as feasible to "the continuous outdoor." In the *Lancet*, May 29, 1915, I made the statement "In serious cases of acute operative toxæmia we have found the placing of the patients out of doors<sup>5</sup> immediately after operation to be of marked benefit," and after a total experience of sixteen years it is pleasant to be able to record<sup>6</sup> that the results have been most gratifying, due to the fact that "the sappers" glory in the fresh air, they love a bit of sun—both of which tend to "get their blood up" to such a standard that their work becomes visible in the daily increase in the color, vigor and appetite of their host—to which may be added immunity to the pneumococcus.

For some years past I have made it a rule to get abdominal patients out of bed on the fourteenth day after operation. At one time I thought it was very smart to have these cases walking seven days post-operative, but

some untoward occurrences forced the conclusion that the practice of allowing active body movement before physiological healing has had time was contra-indicated.

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## MALIGNANT NEOPLASMS OF THE EXTRAHEPATIC BILIARY DUCTS\*

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OF ROCHESTER, MINN.

FELLOW IN SURGERY MAYO FOUNDATION

CANCER of the bile ducts as a clinical and pathologic entity was not recognized previous to the middle of the nineteenth century.

Rokitansky considered that the ducts were involved by secondary growths from near-by organs, and the majority of his contemporary workers agreed with him. Schueppel, in 1878, described the first cancer of the hepatic canal. Durand-Fardel, in 1840, reported the first case of cancer of the common duct, and, according to Mayo-Robson, cancer of the ampulla was first described by McNeal in 1835.

Since 1889 there have appeared reports of collected cases by Musser, Claisse, Devic and Gallavardin, Rolleston, and Outerbridge.

In 4578 necropsies Kellynack found eight cases of carcinoma of the gall-bladder and only two of the ducts. Of 511 operations on the gall-bladder and bile ducts at the Mayo Clinic previous to March, 1903, twenty-two were for malignant disease, and in six of these the growth was believed to be primary in the bile ducts.

### PATHOLOGY

Carcinoma of the bile ducts is usually of the columnar-cell type, according to Ziegler, MacCallum, and Ewing. Rolleston believes that the majority of carcinomas of the bile ducts are derived from the surface epithelium, although he says, "It is possible that spheroidal-cell carcinoma of the bile duct may be derived from the mucous glands in its wall." In an analysis of forty-three cases, he found thirty-seven columnar, five spheroidal, and one colloidal in type. Muroid degeneration of columnar cells, or transition from columnar to spheroidal cells, may take place. Metaplasia may result in the formation of squamous-cell carcinoma, as in the gall-bladder.

Duval describes a case of primary melanoma of the ampulla. No reference to sarcoma was found in the literature. Mayo-Robson and Rolleston both assert that cancer of the head of the pancreas is spheroidal-cell, while cancer of the ducts is almost always of the columnar type. According to MacCarty, the truth of this statement depends on the stage of cellular differentiation, but from a practical point of view this distinction seems to be of little value. According to Ewing, it is difficult, if not impossible, to determine the origin of tumors in the region of the papilla, since they may arise from the intestinal, pancreatic, or biliary tracts.

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\* Abridgment of theses submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfilment of the requirements for the degree of Master of Science in Surgery, April, 1922.

Cancer of the biliary passages most often occurs in the common duct. The lesions in Rolleston's ninety cases were located in the common bile duct in thirty-four (lower end twenty-three, upper end eleven), in the junction of the cystic, common, and common hepatic ducts in twenty-seven, in the common hepatic duct in nineteen, in the right and left hepatic ducts in three, in the cystic duct in six, and in the cystic and lower end of the common duct in one each.

The growth is usually confined within the walls of the bile ducts; it may project into the lumen,

or from an annular stricture, or it may spread along the tube in a diffuse manner, causing obstruction, sooner or later, in all. Extension is usually limited to the walls of the bile duct. By infiltration papillary tumors may invade the liver through the bile ducts, but usually this takes place by the portal lymphatics.

Metastasis seldom occurs; Devic and Gallavardin found metastatic growths in twenty per cent. of cases. In Musser's eighteen cases metastasis occurred in the liver in seven, in the mesenteric glands in one, in the peritoneum in one, and in the pancreas in one. Distant

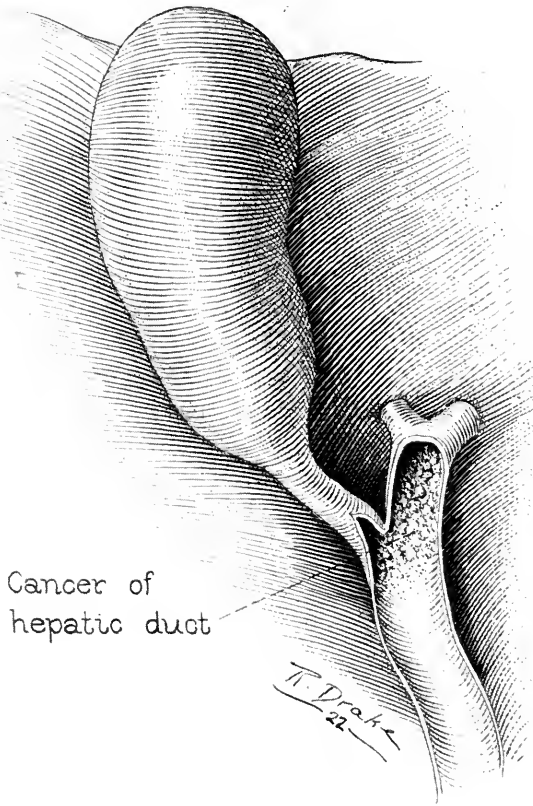


FIG. 1.—Cancer of the hepatic duct, probably originating at junction of hepatic and cystic ducts.

metastasis occurs very rarely. Paynton reports a case of cancer of the common duct, with rapid distant metastasis and death without jaundice. On exploration, small nodules in the liver produced by peripheral dilation of the small intrahepatic bile ducts may be mistaken for metastasis.

The calibre of the ducts remains normal below the growth, while above, the ducts are dilated. In Musser's eighteen cases the ducts were dilated in nine. In patients with involvement of the hepatic or juxtohepatic portions of

the ducts, the gall-bladder is, as a rule, small; at times, however, it is found distended with mucus or in an empyematous condition (Figs. 1 and 2). In cases of tumors involving the common duct or the ampulla the gall-bladder is dilated, unless it has been previously bound down or retracted by infection and stones. In fourteen cases of cancer of the hepatic, common, and cystic ducts reported by Devic and Gallavardin, the gall-bladder was dilated in seven, normal in three, and retracted in four. In ten cases of cancer of the hepatic duct observed at necropsy, the gall-bladder was not mentioned (probably retracted) in three, retracted in four, normal in one, and dilated in two. According to Courvoisier, the gall-bladder is enlarged in eighty-four per cent. of patients with cancer of the duct. The liver is either enlarged or smaller than normal, with dilated ducts filled with bile or clear mucus-like material. Fütterer describes an icteric necrosis in the central zone of the liver lobule with the rest of the structure remaining comparatively normal. He considers this to be due to a reversal of flow of bile to the lymph channels, and Herring and Simpson, in experiments on bile pressure, have described a similar reversal of the bile stream.

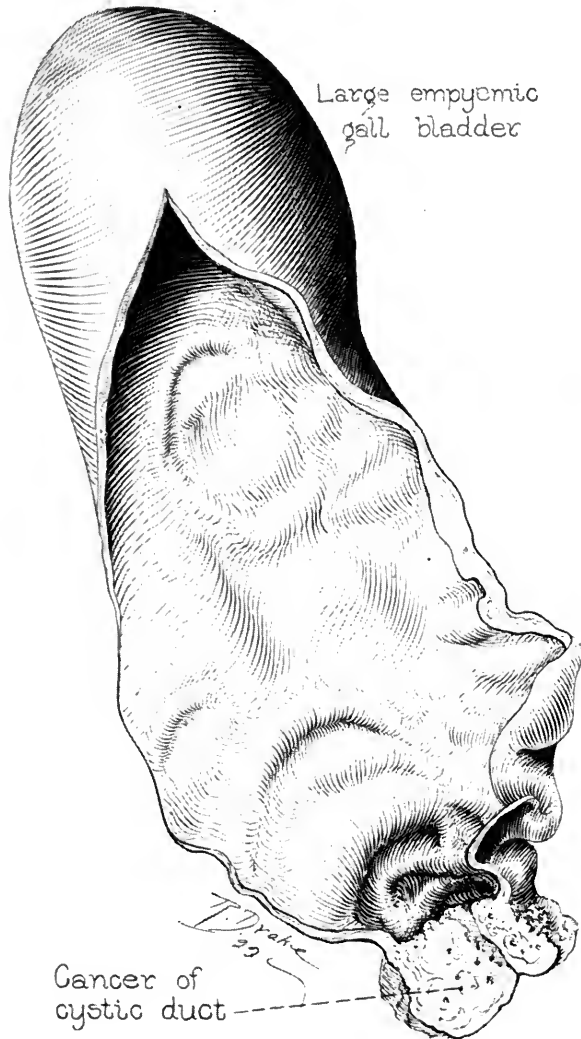


FIG. 2.—Cancer of the cystic duct with a large empyematous gall-bladder.

#### ETIOLOGY

Zenker is of the opinion that primary cancer of the ducts begins as a papilloma and Rolleston reports a case which seems to support this theory.

Mayo-Robson recognizes the possible association of malignancy of the ducts with papilloma, but believes that gall-stones are a greater etiologic factor than is generally conceded. Rolleston says, "It is conceivable that carcinoma of the bile ducts may supervene on an old ulcer as it does in gastric carcinoma." MacCarty<sup>33</sup> presents two cases with reports and photographs of specimens showing duodenal ulcers located at the papilla with definite involvement of the ampulla. In both cases the outstanding symptomatic features are those of gall-bladder disease with symptoms of obstruction.

In Rolleston's series of cases of primary cancer of the ducts, gall-stones were present in about one-third. This percentage is in marked contrast to cases of cancer of the gall-bladder, as stones occur in about seventy per cent. of these. This is supported by Devic, and Gallavardin's and Outerbridge's findings. Keen is of the opinion that cancer arising in the excretory ducts of the liver is seldom associated with stones. McGlinn, however, found eleven cases of cancer of the gall-bladder in 9000 necropsies; eight were associated with gall-stones. In each of five cases of cancer of the bile duct, stones were found. Conradi, in a series of necropsies, found stones in the common duct in nearly fifteen per cent. of cases of cholelithiasis, and White concluded that twenty per cent. of all persons with gall-stones ultimately develop cancer of the biliary passages. Heredity as an etiologic factor is apparently of little importance.

#### AGE AND SEX

Cancer of the bile ducts, in marked contrast to cancer of the gall-bladder, shows a predilection for males. Rolleston notes fifty-five males and thirty-five females; Devic and Gallavardin, thirty males and sixteen females; in Musser's cases they were equally divided.

Like cancer of the gall-bladder, cancer of the ducts is most common between the ages of fifty and seventy. Fifty-eight of Rolleston's eighty-three cases averaged over fifty years, with practically no difference in the two sexes. In Miodowski's series twenty-three were between fifty and seventy, five were over seventy, and eleven were between thirty and fifty.

The clinical picture in malignancy of the ducts is, as a rule, that of an obstructive jaundice, the picture varying with the location of the growth and the associated conditions, such as infection, stones, or pancreatitis. According to Upcutt, the most striking features of the clinical picture are absence of pain, intensity of the jaundice, and extreme emaciation. Rolleston classifies the clinical pictures as follows:

1. Insidious onset, and the first symptom generally jaundice.
2. Acute onset of gastro-intestinal symptoms followed by jaundice, suggestive of ordinary catarrhal jaundice.
3. Vague dyspeptic symptoms for some time preceding onset of obstructive jaundice.
4. Sudden onset of colicky pain simulating impaction of stone.

# CANCER OF EXTRAHEPATIC BILE DUCTS

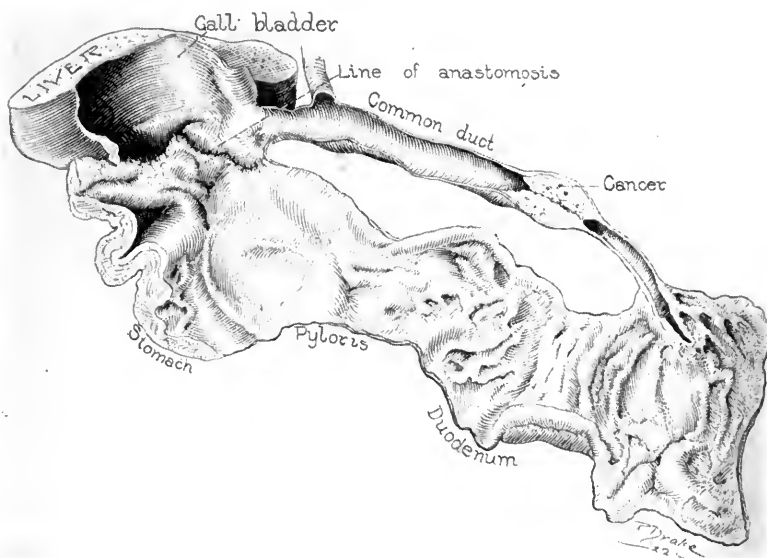


FIG. 3.—Cancer of common duct; ducts dilated above. Cholecystgastrostomy.

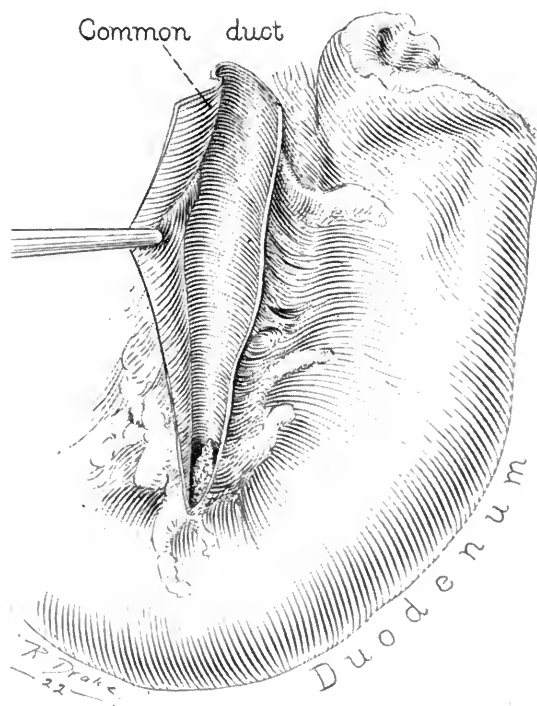


FIG. 4.—Extension of cancer of the ampulla and papilla up into the common duct. Duct dilated.

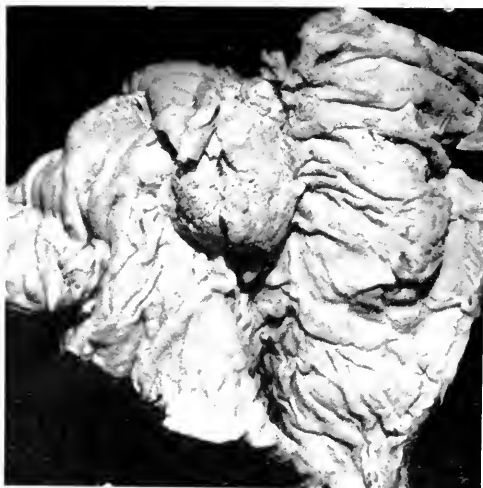


FIG. 5.—Cancer of the ampulla and papilla.

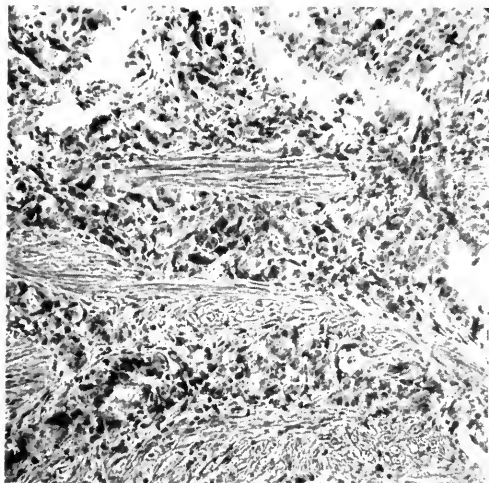


FIG. 6.—Carcinoma of the common duct, mainly cuboidal cells with a tendency to acinus formation (x 100).

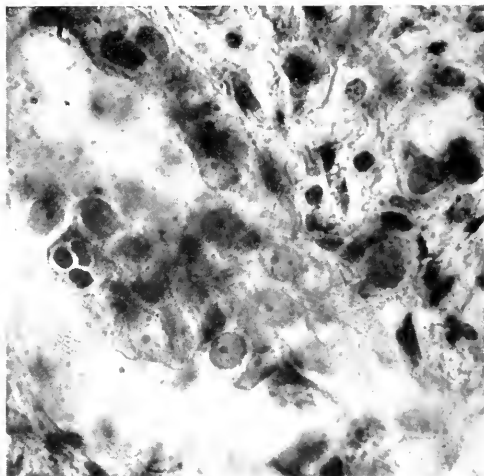


FIG. 7.—Carcinoma shown in FIG. 6.

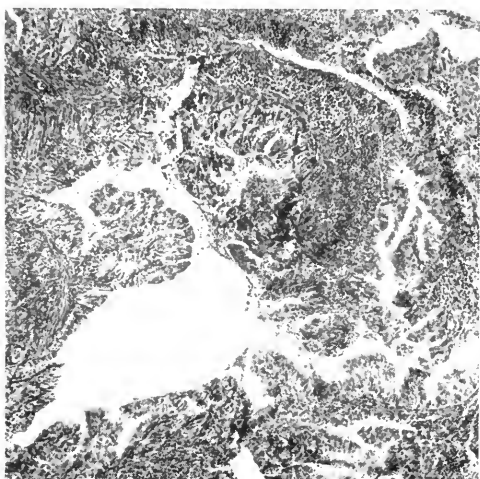


FIG. 8.—Adenocarcinoma of the common duct. Tendency to papillary formation (x 50).

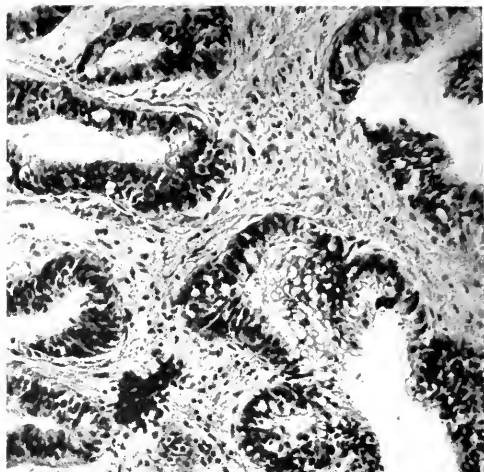


FIG. 9.—Adenocarcinoma shown in Fig. 8 (x 100).

## CANCER OF EXTRAHEPATIC BILE DUCTS

### SURGICAL TREATMENT

The surgical treatment of patients with malignancy of the ducts is either palliative or radical. The pancreatic duct cannot be treated radically and there is a choice of hepatochoangiostomy, with all the objections of a skin fistula and the consequent loss of bile, or hepatochoangio-enterostomy, first suggested by Baudouin in 1896.

Cotte advises hepatochoangiojejunostomy in Y, with the anastomosis to the anterior portion of the left lobe of the liver, because in this part the hepatic duct takes a direct course throughout and has only a short branch, although a fistulous connection is more likely to develop. A jejunostomy in Y is performed with a view to lessening the amount of the ascending infection.

Separate consideration of the cystic duct is not necessary, because its treatment is the same as that for the confluent type; that is, cancer of the cystic, common, and hepatic ducts.

Cancer of the confluent type may be treated by resection of the involved parts, or reestablishment of biliary continuity.

Quénu and Tuffier place the cut end of the duct in the stomach, while Kehr, Terrier and Vautrin place it in the duodenum. Mayo<sup>38</sup> and Jaboulay advise end-to-end suture of the common and hepatic ducts. Cotte advises use of the T-tube because he believes it saves time. Sullivan, in experimental work on dogs, describes the formation

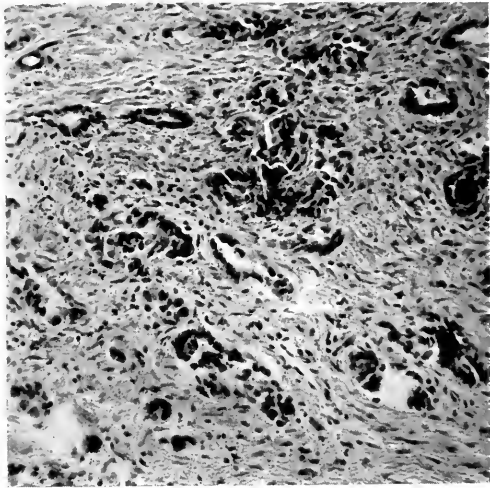


FIG. 10.—Adenocarcinoma (low cuboidal cell) of the common duct (x 100).

of a new duct. He places pure rubber tubing 0.6 cm. in diameter into the pancreatic duct, fastens one end with permanent suture, and passes the other end through the duodenum according to the method of Witzel. The tube is finally covered by omental graft.

Palliative operation in cancer of the confluent type in the presence of infection consists in a cholecystostomy to relieve infection, and to decrease constriction in the duct below by lessening the spasm. This procedure is comparable to gastrostomy with stricture of the œsophagus in which sounds may be passed following gastrostomy. In cancer of the confluent type with little or no infection, some form of anastomosis between the biliary tract and the intestine can be utilized, depending on the site and extent of the lesion. The anastomosis may be between either the gall-bladder or the hepatic duct and the intestinal tract. If the gall-bladder can be used, a cholecystogastrostomy, colostomy, or enterostomy may be performed. Mayo-Robson prefers an anas-

tomosis with the colon, as it is easier, and W. J. Mayo<sup>37</sup> says, "From my experience I see no reason why the colon cannot be used as well as any part of the intestinal tract," and again, "We have joined the gall-bladder to the colon five times for chronic pancreatitis and the patients did fully as well as five patients in whom the duodenum was used. One patient is living five years after operation." Winiwarter, in his original works, considered cholecystocolostomy the method of choice.

Cholecystogastrostomy may be used, and, according to the experimental work of Oddi and the clinical experience of many later surgeons, the presence of bile in the stomach before and during the period of digestion in no way diminishes the power of digestion (Fig. 3).

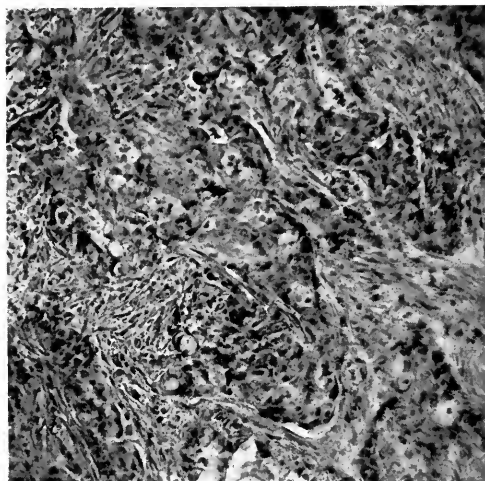


FIG. 11.—Adenocarcinoma of the common duct (x 100).

Either of two methods may be used in the performance of the cholecystenterostomy type of operation: the Murphy button anastomosis, or some form of suture anastomosis. Moynihan<sup>42</sup> found it necessary to perform a cholecystenterostomy only once, and in that case he chose the method of suture anastomosis.

Similar palliative operations may be utilized for cancer of the ampulla and papilla, as in other parts of the biliary tract (Figs. 4 and 5). Types of radical operations available in cancer of the ampulla and papilla are: (1) circular excision of Korte, (2)

transduodenal excision of Halsted, and (3) transduodenal excision or cauterization of the papilla and part of the duodenal wall.

Halsted reports what he believes to be the first case of transduodenal excision for cancer of the ampulla with transplantation of the ducts. The patient died six months after operation. To McBurney belongs the credit for first adopting the method of transduodenal exploration previously suggested by Langenbuch in 1884. Cuneo reports a case similar to Halsted's in which marsupialization of the pancreas was carried out, and the patient died the second day. Retroduodenal resection of the common duct may be performed in these cases.

Occasionally operations on the gall-bladder and ducts are followed by posterior gastro-enterostomy, but Hartman believes that this is seldom necessary, as the great danger is from ascending infection rather than from duodenal obstruction. According to Hartman and others, this infection may be overcome by draining the common duct or gall-bladder. Coffey, from experi-



mental work on transplantation of the bile ducts in dogs, believes infection can be overcome by his method of transplantation.

Kausch devised and carried out successfully a very radical two-stage operation for extensive cancer of the ampulla and duodenal papilla. A Murphy button cholecystenterostomy is followed in two months by resection of part of the duodenum along with the tumor, division and ligation of the common duct, division of the head of the pancreas, gastro-enterostomy, and marsupialization of the stump of the pancreas in the open end of the duodenum. Kausch's patient made a good recovery. Korte advises similar operation.

Brewer asserts that cholecystenterostomy is dangerous and carries with it a mortality of seventy-five per cent.

Quénu reports eighteen collected cases in which radical operation was followed by twelve deaths, sixty-six and six-tenths per cent. Two of the remaining six cases were excluded because of metastasis. The other four patients lived an average of fifteen months (longest two and one-half years, shortest six months).

Lewis reports the case of a patient operated on by Kelly, well eight and one-half years after radical extirpation of cancer of the ampulla.

Deaver and Ashhurst give a rather extensive summary of the various types of operations, with the mortality.

Upcott believes the greater percentage of deaths to be due to hemorrhage. Hepatic inefficiency, cholemia and shock are undoubtedly contributory causes.

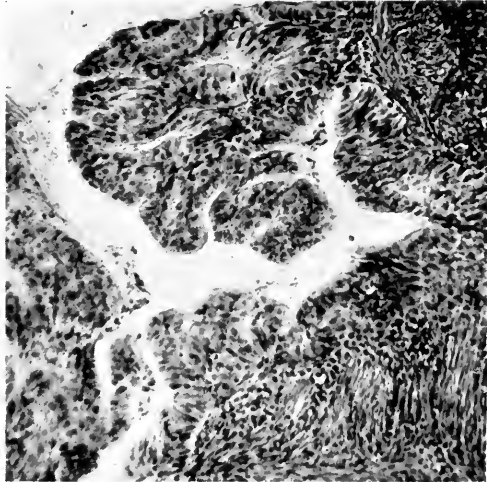


FIG. 12.—Papillary carcinoma of the ampulla of Vater (x 100).

#### MAYO CLINIC SERIES

From January, 1907, to January, 1921, twenty cases of primary carcinoma of the bile ducts were confirmed by pathologic examination at the Mayo Clinic. Eight were of the adenomatous type, two of the papillary type, and all with columnar, cuboidal, or spheroidal cells. Grossly they varied from the annular constricting to the flat, diffuse, and occasionally villous type (Figs. 6 to 13).

The common duct was most often involved. In twelve cases the growth was in the common duct; in four it was at the juncture of the common and cystic ducts, in two at the juncture of the common, cystic, and hepatic ducts, in

one at the upper end of the common duct, and in one at the lower end. In one specimen examined at necropsy the common duct was involved throughout the lower one-third. The hepatic duct was involved once, being associated with disseminated cancer of the intrahepatic bile ducts, probably by direct extension. The cystic duct was involved twice, and the ampulla and papilla five times, one obstructing annular type of growth in the ampulla, and one involving the head of the pancreas.

All but two of the twenty patients were operated on; three patients were explored, palliative operations were performed on eleven, radical operations on four. Specimens were obtained at necropsy in the two patients not operated.

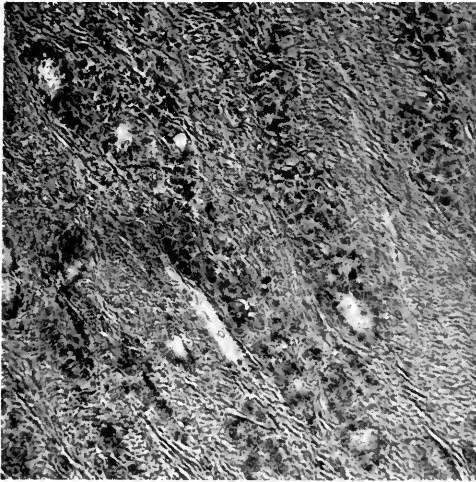


FIG. 13.—Carcinoma of the ampulla (x 100).

Stones were found in eight cases, stony material in two. Stones were found only in one of the five cases in which the growth was at the ampulla. Cancer of the hepatic duct was not associated with stones, while in both cases of cancer of the cystic duct stones were present. Stones were present in five of eleven patients with cancer of the common duct. There was a family history of cancer in only two cases. Thirteen patients were males and seven females. The oldest was seventy-eight years, the youngest twenty-five.

Years	Patients
21-30	1
31-40	3
41-50	2
51-60	7
61-70	5
71-80	2

#### SYMPTOMS

The average duration of obstructive symptoms was five months, the longest fourteen months (cancer of ampulla), the shortest one month (exploration showed metastasis to the liver). Eleven of the patients gave a history of gall-bladder or gall-stone disease preceding the onset of obstructive symptoms, for an average period of five years (longest nine years), while nine of the patients did not give a history of previous trouble. The average loss of weight of fifteen patients was 9.5 kg., associated in the majority of cases with considerable loss of strength. Twelve of the patients had pain varying

## CANCER OF EXTRAHEPATIC BILE DUCTS

from soreness or dull ache in the epigastrium or right hypochondrium to severe typical gall-stone colic, with radiation to the back and shoulders in eight instances. Four patients without stones had typical colicky pains.

All of the twenty patients were jaundiced; eleven constantly, eight intermittently. From the history one could not determine whether the jaundice was of the yellow or green type. Pruritus was definitely present and associated with jaundice in eleven instances, while in five it preceded jaundice. Seventeen patients had clay stools, two had diarrhœa, and one had normal stool. The urine of fifteen contained bile; albumin was present in most instances.

Hemorrhage, as evidenced by petechiæ, purpura, or ecchymosis, was noted five times; one patient had ecchymotic spots over her entire body, and another patient, not operated on, had copious hemorrhage from the bowel the day before death.

Courvoisier advises a search of the history and a careful examination of the entire body in order to ascertain whether or not a predisposition to hemorrhage exists. He says, "Operation may be fatal from hemorrhage not associated with the wound."

In sixteen cases the coagulation time averaged eight minutes; it was ten in four. The liver was palpable in ten cases, the gall-bladder in six, and the spleen in four. Ascites was present in three cases. Chills and fever were noted in seven. Nausea and vomiting seldom occurred after the onset of obstructive jaundice.

### DIAGNOSIS

The diagnosis of malignant conditions of the bile ducts is as difficult, if not more difficult, than that of malignant conditions of the gall-bladder. Usually the chief symptoms are those of a preceding or accompanying gall-bladder or gall-stone disease with insidious or sudden development of symptoms of obstructive jaundice. The obstructive symptoms may appear alone without a previous history of trouble, and may or may not be associated with pain, colic, chills, and fever. Occasionally, the important features are diarrhœa and pasty stools, followed by jaundice. Jaundice is the one almost constant feature and may be preceded or followed by distressing pruritus. Loss of weight and strength is, as a rule, marked. A tumor may or may not be felt and with the possibility of numerous extrahepatic conditions producing the obstruction, a diagnosis other than obstructive jaundice is almost impossible. In a male in the fifth or sixth decade of life with a history of insidious persisting obstructive jaundice, malignancy of the ducts is always possible.

Moynihan says, "No one living is infallible in the differential diagnosis of obstructive jaundice, the diagnosis is always difficult and the chance of life saved is so important, that, however positive the evidence of malignancy may be, I have advised operation in all cases."

# KINSLEY RENSHAW

## DIAGNOSIS IN TWENTY CASES

	CASES
Obstructive jaundice, malignancy questionable .....	9
Obstructive jaundice, stones or malignancy .....	8
Cholangitis .....	1
Disease of the gall-bladder .....	1
Cirrhosis or malignancy .....	1

## TYPES OF OPERATION

Of eighteen operations, three were explorations, eleven were palliative, and four were radical. Metastasis was found in four cases; two of cancer of the ampulla with metastasis of the liver, one of cancer of the ampulla involving the head of the pancreas by direct extension, and one of cancer of the hepatic duct with metastasis to the liver (at necropsy this appeared to be by direct extension along the ducts). Pancreatitis was noted seven times, and cirrhosis seven times. In three cases the ducts contained white bile.

## RESULTS

The operative mortality of this series of cases (thirty-three and three-tenths per cent.) compares favorably with that reported by others. The average post-operative length of life of thirteen patients of the series was a little more than five months, one patient living fifteen months and another a little more than three years.

Case (A118598). The patient came to the Clinic with a history of diarrhoea of fourteen months' duration, jaundice, weakness and anæmia, gradually increasing pain in the right costal margin, with periods of remission. Cholecystostomy had been performed elsewhere about two months previously, and was followed by a persistent biliary fistula and loss of forty pounds in weight; the hæmoglobin was twenty-five per cent. Death occurred eighteen months after the onset of symptoms. Necropsy revealed primary cancer of the ampulla with involvement of the head of the pancreas.

Case (A340400). The patient had been well until five months before. Following a big dinner, indigestion occurred with very loose, mushy stools, and jaundice two weeks later. There was no history of colic, chills, fever or hemorrhage. The liver and gall-bladder were enlarged and pruritus was severe. The blood urea was 106, urea nitrogen fifty, phenolsulphonephthalein return thirty-five per cent., hæmoglobin sixty per cent., coagulation time nine minutes. The patient lost thirty-five pounds in weight. While under observation petechial hemorrhages developed with marked bleeding from the bowel the day before death. Death occurred about six months after onset of symptoms. Necropsy revealed carcinoma of the common duct, and chronic pancreatitis.

The twenty cases of malignancy of the biliary tract were divided into four groups.

# CANCER OF EXTRAHEPATIC BILE DUCTS

TABLE I

Case	Location	Exploration	Duration of life
A115806	Common duct	Abdominal incision, specimen for diagnosis	Six weeks
A45192	Common duct	Abdominal incision, specimen for diagnosis	Left the hospital seventh day
A208988	Ampulla	Abdominal incision	Ten days
PALLIATIVE OPERATION			
A197147	Hepatic duct	Cholecystostomy, liver puncture, and drainage	Forty-eight hours
A91510	Cystic duct	Cholecystostomy, specimen from cystic duct	Dead. Date unknown
A253416	Common duct	Cholecystostomy, specimen for diagnosis	Seven days
A207955	Common duct	Cholecystostomy, specimen for diagnosis	Dead. Date unknown
A163919	Common duct	Cholecystostomy and choledochostomy with T-tube extending through common duct into pancreatic duct and duodenum	Five months
A66344	Common duct	Choledochostomy with T-tube drainage	Five months
A62646	Common duct	Cholecystoduodenostomy (Cholecystostomy previously, elsewhere)	Two months
A137890	Common duct	Cholecystogastrostomy	Twenty-four hours
A74038	Common duct	Cholecystectomy with removal of part of the anterior wall of the common duct; Robson hepaticus drain	Two months
A226626	Ampulla	Choledochostomy with transduodenal exploration, specimen from papilla	Fifteen months
A180037	Ampulla	Cholecystogastrostomy. (Patient returned with pyloric obstruction, posterior gastro-enterostomy.)	Three years
RADICAL OPERATION			
A120992	Cystic duct	Cholecystectomy, resection of cystic duct with involved parts of common and hepatic ducts, anastomosis over T-tube	Three months
A35861	Common duct	Choledochotomy, cholecystectomy with removal of all the cystic duct and part of the common duct plastic on common duct.	Result unknown
A253761	Common duct	Excision of growth of common duct with end-to-end anastomosis; interrupted sutures	Result unknown
A269833	Ampulla	Choledochotomy, transduodenal excision (knife and cautery) cholecystoduodenostomy	Nine days

## KINSLEY RENSHAW

Group 1. Cases in which there was a history of gall-stone disease for a variable period, later associated with or followed by symptoms of obstructive jaundice.

Group 2. Cases in which the history of gall-bladder disease was variable for a number of years, later associated with or followed by symptoms of obstructive jaundice.

Group 3. Cases in which symptoms of obstructive jaundice developed, the insidious, painless type, or associated with pain.

Group 4. Cases in which there was a history of diarrhoea and pasty stools, of the pancreatic type, followed later by symptoms of obstructive jaundice.

### DISCUSSION

Surgical treatment of malignant conditions of the biliary tract has not advanced proportionately with that of other parts of the upper abdomen. Technical difficulties themselves do not seem to be responsible for this comparative tardiness.

Apparently the element that either prevents operation or causes failure, in a large percentage of cases, is hemorrhage. Recent clinical investigations on the control of hemorrhage in jaundiced patients by the intravenous administration of calcium have been carried out by Walters of the Mayo Clinic, and seem to advance some hope for better results in these cases. Certain pre-operative and post-operative principles designed to conserve and stimulate the activity of the cells of the liver were recently reiterated and emphasized by Crile.

If it were not for hemorrhage, malignant conditions of the biliary ducts, being as a rule small, limited within the walls of the bile ducts, and late to metastasize, should lend themselves readily to surgical treatment.

### CONCLUSIONS

1. Malignancy of the bile ducts, while less common than that of the gall-bladder, is not uncommon. The ratio in a series of 104 cases of malignancy of the biliary ducts and gall-bladder was one to four.<sup>36</sup>

2. Carcinoma is the most common type of neoplasm found.

3. Gall-stones would seem to be of greater etiologic importance than is generally considered.

4. Males and females are affected in the ratio of about two to one.

5. About two-thirds of the cases occur between the ages of fifty and seventy years.

6. A diagnosis of malignancy of the ducts is uncertain.

7. After a diagnosis of obstructive jaundice has been made, exploration is generally advisable.

8. From the standpoint of slowness of growth and rarity of metastasis, surgical treatment should be favorable.

9. Early treatment of disease of the gall-bladder may occasionally prevent the development of malignancy.

10. Operation on patients with jaundice carries a high mortality.

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## PERFORATION OF DUODENAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

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THE occurrence of perforation of peptic ulcers following gastro-enterostomy is an accident of sufficient rarity to be reported. Such perforation is relatively less common than accidental post-operative hemorrhage following gastro-enterostomy or hemorrhage due to the erosion of a large blood-vessel.

It is well known that peptic ulcers may continue to exist, or even progress, following gastro-enterostomy with or without exclusion of the pylorus or inversion of the ulcer. Hemorrhage from continued activity of an ulcer following gastro-enterostomy without perforation is relatively frequent.

The total number of cases of perforation following gastro-enterostomy, which have been found after a careful search of the literature, numbers twenty-nine cases. In twenty-eight of these cases death followed from hemorrhage or peritonitis. In fifteen cases a posterior gastro-enterostomy was done and in four cases anterior gastro-enterostomy. In eleven cases the perforation followed a simple posterior gastro-enterostomy. In four cases the perforation followed a posterior gastro-enterostomy plus pyloric exclusion. Ten cases presented perforation following operative procedures which are not given in detail in the reports.

Of the twenty-nine cases reported in the literature the location of the ulcer in nineteen was in the duodenum. In eight cases the ulcer was in the stomach. In the remaining two cases the location of the ulcer is not definitely stated. The close relationship between post-operative gastro-intestinal perforations and the occurrence of hemorrhage requires these two accidental conditions to be considered together. In thirteen of the fatal perforations it is stated that death was due to hemorrhage, while in fourteen cases death is ascribed to peritonitis. In the two cases reported by von Eiselsberg, the immediate cause of death is not clear. In one of these cases the cause of death is given as progressive extension of the ulcer and in the other case the cause is given as perforation, without detail.

In four of the twenty-nine cases it is stated that the gastro-duodenal or the pancreaticoduodenal artery was eroded following the gastro-enterostomy. Thompson<sup>8</sup> states that the gastro-duodenal artery is more likely to be involved than any other vessel owing to its anatomical relationship with the first part of the duodenum. Deep eroding ulcers occupying the posterior wall are pretty sure to extend to this vessel sooner or later and there may be severe hemorrhage if the extension of the disease is sufficiently marked.

It seems to be proven fairly well from experience in many cases that gastro-enterostomy as an operative procedure, in itself, checks hemorrhage

from duodenal ulcers. However, the large number of cases in which this result has not occurred should suffice to put surgeons on their guard not to trust absolutely to the operation of gastro-enterostomy with or without exclusion to stop hemorrhage or perforation, even after the infolding of the ulcer, as occurred in our own case.

CASE.—The case which it is desired to report here is as follows: A. C. M., age forty; male; American; physician; was admitted to St. Vincent's Hospital, September 27, 1921. Operated September 28th, with death October 4, 1921. Pre-operative history: While in service in France had an acute attack of pain in the abdomen; was sent to the hospital with a diagnosis of acute appendicitis. Operation was not performed at this time. The patient was able to return to duty in ten days, but occasionally had distress after meals—this would clear up and he was relieved for several months. For past six or eight months he would eat between meals and this relieved his distress; occasionally he would get up at night and drink milk or eat a cracker. There was no acute pain or blood in stool.

There was nothing in the present condition indicating that the ulcer was about to perforate. Operation was done under ether anæsthesia during which a posterior gastro-enterostomy, without loop, and also a routine appendectomy through an upper right rectus incision. The ulcer was found on the anterior wall of the duodenum about one-half inch from the pylorus. The base of the ulcer was found to be indurated without any evidence of perforation. The ulcer base was folded in with interrupted linen and then covered by an omental graft. The usual posterior gastro-enterostomy was done, excepting that owing to the thickness of the abdominal wall I was unable to use a clamp on the stomach. The catgut sutures in the anastomosis were reinforced with interrupted linen.

The gall-bladder was found to empty freely and to contain no stones. No enlarged glands were found along the ducts. The abdomen was closed in the ordinary manner. Following the operation the temperature and pulse remained normal during the first twenty-four hours. The patient complained of being thirsty and showed the usual post-operative discomfort. The abdomen was not distended. On the day following, September 29th, the patient complained of severe thirst and also moderate vomiting. There was slight distention but no pain. The next day, September 30th, the condition of the patient seemed to be considerably improved. There was moderate abdominal distress, but the patient had slept most of the night; the pulse was of good volume. On October 1st he complained of severe gas pains in lower abdomen attended with marked restlessness. Patient did not sleep well, although the pulse remained good. The next day the abdominal distention was more marked, with an increase in the restlessness and nervousness of the patient. His condition was more serious the day following with rapid respiration, weak pulse, subnormal temperature, and death occurred at 5 A.M. October 4, 1921.

PERFORATION OF DUODENAL ULCER  
Following Gastro-enterostomy

Case No.	Reporter and Reference	Pathology	Operation	Post-operative Complications	Result	Remarks
1	Eve. Lancet, London, 1908, 1, 1822.	Duodenal ulcer.	Anterior G. E. because the stomach was bound down by posterior adhesions.	Patient died 40 days later.	Autopsy showed an ulcer on inner surface of duodenum with ragged base extending deeply into pancreas.	Death due to uncontrollable malæna.
2	Petren, Beitr. z. klin.Chir. 1911, lxxvi, 305.	Case 2, p. 336, of this series, operated for gastric hemorrhage.	Posterior retrocolic G. E.	Hemorrhage 3rd day. Death 5th day.	Autopsy showed the defect in the mucous coat with small eroded vessel.	Death due to hemorrhage.
3	Petren, Beitr. z. klin.Chir. 1911, lxxvi, 305.	Case 3, p. 336, of this series, operated for gastric hemorrhage.	Retrocolic posterior G. E. and enteroanastomosis.	Death on 4th day.	Autopsy showed organs anemic and small perforated ulcer on curv. min. near cardia.	Death due to hemorrhage.
4	Petren, Beitr. z. klin.Chir. 1911, lxxvi, 305.	Case 1, p. 336, of this series, operated for severe gastric hemorrhage.	Retrocolic posterior G. E.	Death 2 days later. Perforated duodenal ulcer near pylorus, the perforation being clear through to the pancreas.	Verified by autopsy.	Ulcer size of 2 mark piece. Due to hemorrhage.
5	Petren	Case 7, p. 337, of this series, situation of ulcer not stated.	G. E.	Bloody vomiting evening and night after operation with bright red blood. Relaparotomy 2nd day with gastrostomy.	Date of death not stated.	Further particulars not given. Death due to hemorrhage.
6	Petren	Case 7, p. 338, of this series, ulcerus ventriculi.	Retrocolic posterior G. E.	Blood in stool 5th day and later. On 12th post-op. day sudden high grade anemia. Died 5 days later.	Autopsy showed perforated ulcer on posterior face of stomach. The art. lienalis was eroded.	Death due to hemorrhage.
7	Petren, Beitr. z. klin.Chir. 1911, lxxvi.	Case 3, p. 332, of this series, ulcerus ventriculi.	Anterior antecolic G. E. with enteroanastomosis.	Symptoms of perforation peritonitis on 5th day. New laparotomy and drainage 18 days after G. E.	Died the day following reoperation. Autopsy showed perforated ulcer in the posterior wall of stomach.	Death due to peritonitis. The perforation appears due to retraction of the shortened curve.
8	Petren	Case 8, p. 338, of this series, pyloric ulcer tumor.	Antecolic and anterior G. E.	Voluminous bloody vomiting on 4th day. Death on 5th day.	No further particulars given.	Death due to hemorrhage.
9	Petren	Case 8, p. 333, of this series. Situation of ulcer not stated.	Retrocolic posterior G. E.	Death after 6 days.	Autopsy showed a small perforation in the G. E. loop.	Death due to hemorrhage.
10	Petren, Beitr. z. klin.Chir. 1911, lxxvi, 319.	Case 15, p. 331 of this series Operated for ulcerus ventriculi and chronic perigastritis.	Retrocolic posterior G. E.	Stomach and liver adherent at site of tumor. Left hospital feeling well. Returned later with symptoms of peritonitis. Relaparotomized.	Small perforation found in the stomach wall in the site of the adhesions between the stomach and liver and parietal peritoneum.	Patient made a good recovery.
11	Pelissier, Bull. Soc. Anat. de Paris, 1912.	Pyloric stenosis with ulcer. Pyloric region blocked by adhesions.	G. E.	Patient died suddenly 3rd day after operation.	The death was due to peritonitis.	Autopsy showed a perforation on anterior face of first portion of duodenum running into scar tissue blocking pylorus. Operative rupture of adhesions to inferior face of gall bladder had caused peritonitis

# PERFORATION OF DUODENAL ULCER

## PERFORATION OF DUODENAL ULCER Following Gastro-enterostomy

Case No.	Reporter and Reference	Pathology	Operation	Post-operative Complications	Result	Remarks
12	Thompson, Annals of Surgery, 1912, lvii, 695.	Duodenal ulcer posterior wall, blood in stools for 6 months previous.	Posterior G. E. ulcer not infolded.	Died 34 hours after operation symptoms of internal hemorrhage.		No autopsy. Author surmises from the position of the ulcer that gastro-duodenal artery eroded.
13	Thompson	Duodenal ulcer; posterior wall, worms in stools for 6 months previous.	Posterior G. E. ulcer not infolded.	Died with symptoms of hemorrhage 42 hours after operation.	Autopsy showed that the ulcer had perforated post-operatively.	The hemorrhage came from the eroded gastro-duodenal artery.
14	Mayo-Robson, Lancet, Lond., Feb. 9, 1901, 378.	Hemorrhage supposed to be from a gastric ulcer.	Anterior G. E. with Murphy button.	Severe abdominal pain on 6th day; patient died 10 days after operation from perforation at site of the anastomosis.	Death was due to peritonitis due to leakage when the button began to separate.	Autopsy gave no evidence of gastric ulcer, but there was large deep duodenal ulcer at bottom of which gastro-duodenal artery was found with an ulcerated hole in its side completely closed by a firm thrombus.
15	Horak, Zentralbl. f. Chir., 1921, xli, 1088.	Duodenal ulcer.	Posterior Hacker-Hochenegg, G. E. without pyloric exclusion.	Perforation of ulcer 3 days after operation.	Death	
16	Kaspar, Deut. Zeitsch. f. Chir., 1914, cxxxi, 531.	Case 9, p. 578, of this series, hemorrhagic ulcus duodeni.	Retrocolic posterior G. E. with exclusion.	Severe vomiting following day. Relaparotomized.	Death	
17	Kaspar, Deut. Zeitsch. f. Chir., 1914, cxxxi, 531.	Case 2, p. 576, of this series. Stenosing transpyloric duodenal ulcer.	Patient's state did not admit of radical operation. Simple G. E. only.	Death 3 days later. Perforation of duodenal ulcer in the anterior wall.	Findings at autopsy.	It is probable that ulcer had perforated before operation, but was not recognized at time of operation.
18	Kaspar, Deut. Zeitsch. f. Chir., 1914, cxxxi, 531.	Case 38, of this series, ulcus ventriculi, or ulcus duodeni with hemorrhage.	Retrocolic posterior G. E.; pylorus ligatured; ligature of art. pancr. duod.	Death 9 hours later.	Autopsy showed chronic ulcer of posterior wall of pars horiz. duod. Erosion of large branch of the truncus coeliacus.	
19	Le Roy des Barris, J. de chir., Paris, 1913, xi, 479.	Case diagnosed as gastric ulcer; found to be inextirpable ulcer of duodenum pyloric region.	Posterior G. E. pylorus not excluded.	Vivid pains 4th day after operation. Died 13 days after operation.	Autopsy showed no peritoneal reaction; large amount of effused blood in all intestine. Ulcer was in posterior face of pyloric region and at its site a large patch of intestine had disappeared.	Death was due to perforation of the portal vein by progress of the ulcer despite the G. E.
20	Horwitz Arch f. klin. Chir., 1917-18, cix, 567.	Case 11 of this series. Ulcer duodeni.	G. E.	Vomitus bloody the day after operation. Treated by lavage, salt infusion, etc. Patient very weak. Died.	Autopsy showed fluid blood from small perforation in posterior wall of duodenum. G. E. edges also hemorrhagic and a bleeding polyp found there.	
21	Vulliet Rev. med de la Suisse rom., 1918, xxxviii, 688.	Case 6, of this series. Pyloric stenosis.	Retrocolic posterior G. E. without any loop.	Patient reoperated for complication on 6th day. Anterior button G. E. simple. Patient died 7 days later.	Autopsy showed that traction of anastomosed loop caused a large tear in the serosa and exposed the button.	Perforation probably occurred intra vitam.

PERFORATION OF DUODENAL ULCER  
Following Gastro-enterostomy

Case No.	Reporter and Reference	Pathology	Operation	Post-operative Complications	Result	Remarks
22	Carr J. Am. M. Assn., 1919, lxxiii, 34.	Pyloric ulcer. Ulcer on anterior side of pylorus with no suggestion of impending perforation.	Posterior G. E. (low) and appendicectomy.	Vomiting, etc. on 6th day. Died 7th day.	Autopsy showed that the induration about the ulcer had subsided and its base was perforated. Perforation had the diameter of a lead pencil.	Died from peritonitis.
23	Troell, Deut. Zeitschr. f. Chir., 1919, cxlviii, 404, cxlix, 1.	Case 26 of this series. Ulcer of duodenum; adhesions and hardening of the horizontal part of the duodenum found at operation, but which did not suggest ulcer.	Palliative G. E. and partial pyloric exclusion.	Ulcer perforated 20 hours after the operation and the patient died.	Autopsy showed that death was due to perforation peritonitis.	Author says that all adhesions should be cleared when making the operation, as they are deceptive.
24	Hohlbaum, Arch. f. klin. Chir. 1919-20, cxiii, 499.	Case 1, of this series, chronic duodenal ulcer; ulcer at operation found on posterior part of the duodenum; the anterior wall was succulent.	Posterior G. E. with pyloric exclusion.	Perforation of ulcer the day after operation. Patient died.	Autopsy showed that the ulcer in the anterior wall had perforated.	Death due to peritonitis.
25	Hohlbaum, Arch. f. klin. Chir. 1919-20, cxiii, 499.	Case 2, of this series, chronic duodenal ulcer.	Simple G. E.	Perforation of ulcer of duodenum the day after operation. Patient died.	Perforation of ulcer on anterior wall of duodenum verified at autopsy.	Death due to peritonitis.
26	Pinocchio, Semana Med., 1918, xxv, 699.	Case 62, of this series. At operation hard tumor found at pylorus adherent to pancreas.	Usual G. E.	Patient reoperated 9th day for complications. Death 12 days later.	Autopsy showed 2 ulcers on the posterior face of the first portion of duodenum, one of which 2 cms. in diameter had perforated into the pancreas.	Death due to peritonitis.
27	Pinocchio, id.	Case 37, of this series. Operation: ulcer of small curvature of stomach and pylorus and adherent to inferior part of liver.	G. E.	Severe hematemesia on 5th day. Symptoms of acute anemia and death.	Autopsy showed ulcer situated posterior face of the first part of duodenum. The gastro-duodenal artery was found in its fundus ruptured.	Death due to hemorrhage.
28	v. Eiselsberg, Surg. Gyn. and Obst., 1912, xix, 555.	Out of 334 gastro-enterostomies of stomach for duodenal ulcer there were six immediate post-operative deaths due to hemorrhage from an ulcer; also one death from progressive extension of the ulcer. In the later results six died from extension of the disease, one case of which was a perforation.				
29	Sherren, Surg., Gyn. and Obst., 1914, 567.	In 78 cases of gastro-jejunostomy for gastric ulcer without excision, two cases had to be operated again "which had perforated and were adherent to the pancreas." Both recovered. Treats chronic duodenal ulcer by infolding the ulcer when on the anterior wall and posterior gastro-jejunostomy.				

Post-mortem showed a well-developed adult male, apparent age forty, very little post-mortem discoloration. Chest and abdomen opened through median incision. There was a thick layer of subcutaneous fat over the abdomen. The body had been previously embalmed and the gut

punctured with leakage of the intestinal contents within the abdominal cavity. The small intestine presented evidences of slight inflammation. Examination of the gastro-enterostomy wound revealed no evidence of leakage or obstruction of the opening. There were three deep ulcers in the duodenum. One ulcer was of the perforating type with destruction of the entire mucosa in the ulcer crater. One ulcer had perforated through the peritoneal coat with discharge of duodenal contents along the sutured area where an attempt had been made to cover over the ulcer base during the operation. The liver was small and there was evidence of fatty degeneration. Both kidneys were small and there was chronic interstitial nephritis. The spleen, pancreas, lungs, heart were found to be normal.

Larrien, in a recent article published in 1921, states that he has been able to collect eighty-one cases in which there was perforation of the ulcer following the operation over a prolonged period of time. However, we are concerned in this particular study more particularly with cases which have perforated immediately following the operation and in this type of cases the number found by Larrien is only twenty-eight. Larrien thinks that post-anæsthetic vomiting and stomach lavage done without due precaution favor perforation. The nature of the ulcer is also a factor. In certain instances the perforation has occurred prior to the operation but is walled off by adhesions. Another cause of perforation is traceable to the defective functioning of the enterostomy. As a general rule, when the gastro-enterostomy functionates well, the ulcer cicatrizes rapidly, and, in a contrary way, if the opening is not working satisfactorily, the ulcer persists in an active stage.

*Diagnosis.*—When the symptoms of perforation follow soon after operation, they may be confused with “circulus virtiosus” or with post-operative dilatation of the stomach. A distinction must also be made from peritonitis developing from causes other than perforation. The diagnosis may be made with great difficulty inasmuch as the symptoms are masked more or less by the symptoms following operation, such as abdominal pain, increased pulse-rate, and increased temperature. The occurrence of sharp pain appearing without premonitory signs in a patient otherwise doing well, should make one very suspicious of a perforation. Stress should be laid upon the appearance of symptoms of an abrupt nature appearing in the case of a patient otherwise doing well. When the ulcer has been infolded and the perforation does not permit the contents of the gastro-intestinal canal to reach the peritoneal cavity suddenly, the symptoms may be delayed and render the diagnosis exceedingly difficult, if not impossible.

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- <sup>3</sup> Graham: Bost. Med. and Surg. J., 1914, vol. clxx, p. 221.
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- <sup>13</sup> Vander Veer: ANNALS OF SURGERY, 1921, vol. lxxiv, p. 362.
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## LYMPHOSARCOMA OF THE INTESTINE

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LYMPHOSARCOMA of the intestinal tract is a fairly rare condition, and the literature on this subject presents a confusing picture in which the microscopic details are obscure. The condition may occur in any portion of the alimentary tract, the seats of election being the stomach, lower ileum, and rectum. Lymphosarcoma of the intestine is much less frequent than carcinoma. The relation of these two tumors is about one to twenty. Lymphosarcoma may involve either the small or large intestine, while carcinoma is far more frequently found in the large intestine and rectum.

Krugerz Boas,<sup>1</sup> who collected reports of thirty-seven cases of sarcoma of the intestine, found the small intestine involved sixteen times, the ileocæcum once, the cæcum twice, the vermiform appendix once, the transverse colon once, both the small and large intestine once, and the rectum sixteen times. Smoler<sup>2</sup> states that there occurs one case of sarcoma of the small intestine in every thousand autopsies; he found thirteen cases in 13,036 autopsies. The distinction between round-cell sarcoma and lymphosarcoma was apparently made very seldom.

During the last twelve months in the Department of Pathology of the Albany Hospital two cases of lymphosarcoma of the small intestine were encountered, a description of which constitutes the basis of this paper.

I wish to express my thanks to Dr. A. W. Elting and Dr. J. A. Sampson for the use of the clinical facts associated with the cases and to Dr. V. C. Jacobson for the assistance he gave me in the preparation of the pathological material.

CASE I.—H. S., male, Jew, aged twenty-six years, chauffeur. He entered the Albany Hospital, February 11, 1921. His chief complaint was loss of appetite and gastric distress after eating. His family history is negative. He had always been in good health. Measles was the only sickness he remembers having had when a child. His bowels were regular before his present illness. His trouble dated back to November, 1920, when he began having sharp pains in the epigastrium following eating. He belched considerably and was nauseated, but he never vomited. Meat seemed to cause the most distress and this lasted one-half to one hour after eating and was not relieved by taking food. His appetite diminished and his

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\* Dr. DeNoyelles died May 23, 1922. He was a very conscientious worker in surgical pathology and this study of intestinal lymphosarcoma by him is most creditable, particularly in view of the fact that he was a constant sufferer from nephritis while engaged in its preparation. His premature death cut short what gave evidence of being a highly successful professional and scientific career. (V. C. Jacobson.)

condition gradually became worse. His average weight was 147 pounds, on February 14th it was 145 pounds.

*Physical Examination.*—In general the patient's condition seemed good. The pupils reacted to light and accommodation. The heart and lungs were normal. There were bilateral palpable inguinal lymph-glands. Except for the abdomen, the physical examination was entirely negative. His abdomen was very muscular and rigid throughout. When he flexed his thighs a mass was visible in the upper right umbilical region. It moved with respiration, followed the movement of the diaphragm. Pressure over mass caused some spasm and referred pain in the epigastrium. The most tender point was over the border of the right rectus muscle, midway between the umbilicus and the margin of the ribs. On palpation the mass seemed superficial, firm and smooth. By pressing forward with one hand in the costo-vertebral space, the mass was more readily palpable. Pulse, temperature



FIG. 1.—Drawing of the tumor in Case I.

and respirations were normal. Systolic blood-pressure was 128; diastolic 80. The blood Wassermann reaction was negative. The blood examination showed hæmoglobin eighty per cent. (Sahli); white cells 12,000. The urine was amber, slightly cloudy; specific gravity, 1.016, acid, and contained a slight trace of albumin. The sediment consisted of mucous shreds, a few pus cells, and a rare shadow of a red blood-cell. A stool gave a strongly positive reaction for occult blood. Röntgen report; a barium meal showed the œsophagus normal, the stomach high in position and of the modified 'steer-horn' type; no filling defects, incisura or notches. The pylorus seemed smaller than usual and gave the impression that it was pushed up or pulled up into its present position. The cap was smooth and regular in outline. The barium enema revealed nothing abnormal except for an abnormally high position of the transverse colon. The urinary and biliary tracts were negative upon X-ray examination.

*Course of the Disease.*—The patient left the hospital on February 16, 1921, and on February 24, 1921, he returned, his condition having become worse, and his appetite very poor. He felt weaker and was extremely constipated. His weight was 139 pounds. Hæmoglobin seventy per cent. The stools were again strongly positive for occult blood. He was told an exploratory operation was necessary. Operation,

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March 4, 1921, revealed a tumor of the jejunum about sixteen inches from the ligament of Treitz. This tumor encircled the jejunum, being about five inches in length and three inches in diameter. Below it the lymph-glands were as large as English walnuts and extensively involved, some being a considerable distance from the intestinal tumor. The extremities of this tumor were rather sharply defined. The tumor was adherent to the omentum and transverse colon. The intestine containing the mass was resected and a lateral anastomosis done. Radium was placed in the region of the mesenteric gland involvement, the usual precautions being taken. The patient expired March 7, 1921. Permission for necropsy could not be obtained.

*Pathological Examination.*—The specimen consists of a loop of small intestine with a kidney shaped annular tumor mass involving practically all of it. The tumor measures 11.5 cms. in length, 8 cms. in diameter, and weighs 330 grams.

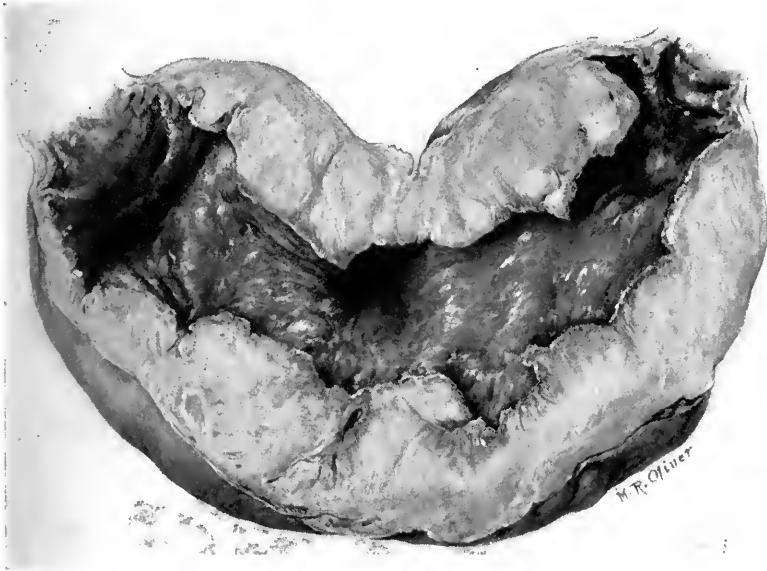


FIG. 2.—Drawing of the tumor in Figure 1, opened by a longitudinal incision. The narrowing of the lumen of the gut is shown. The mucosa is practically entirely destroyed by the tumor which infiltrates the entire wall.

The serosa has many tags attached to it. There are also many dilated blood-vessels in the serosa. The tumor is uniformly firm with a few groove-like depressions on its surface. A longitudinal incision shows the wall to be firm and varying in thickness from 1.5 to 3 cms. It is translucent and grayish pink, all the layers of the intestinal wall seem to be paced by this tumor mass. A lumen is present throughout, varying in diameter from two to three centimeters. The mucosa is ulcerated and covered in places by tarry semi-solid material (Figures 1 and 2).

*Microscopical Examination.*—Tissue was fixed in ten per cent. formalin-alcohol and embedded in paraffin. Sections were stained with hæmatoxylin and eosin. A study of the sections discloses the following facts.

The tumor consists of a diffuse growth of lymphoid cells lying in a coarse recticulum. The intestinal wall is almost entirely replaced by tumor cells with the exception of a few glands that are still present. The cells of the tumor vary much in size. There are areas of small cells, hyperchromatic with dense nuclei of the

lymphocyte type. However, most of the cells are fairly large with somewhat vesicular nuclei. Two nuclei are present in many large cells. Many of the nuclei are lobulated, and mitotic figures are numerous. Many of the cells of the tumor resemble quite closely the transitional cell of the blood or clasmatocyte (Sabin). The smaller cells appear to be lymphocytes of various sizes, many in mitosis.

CASE II.—Mrs. P. H. K., American, age thirty-nine, housewife, entered the Albany Hospital, October 4, 1921. Her chief complaint was pain in the abdomen, considerable belching of gas, nausea and vomiting. Her family history was negative. She had had no children, and no miscarriages. Her menstrual periods were regular, normal in amount and duration. Her general health had been good. She had had pneumonia in 1917. She had been somewhat constipated for many

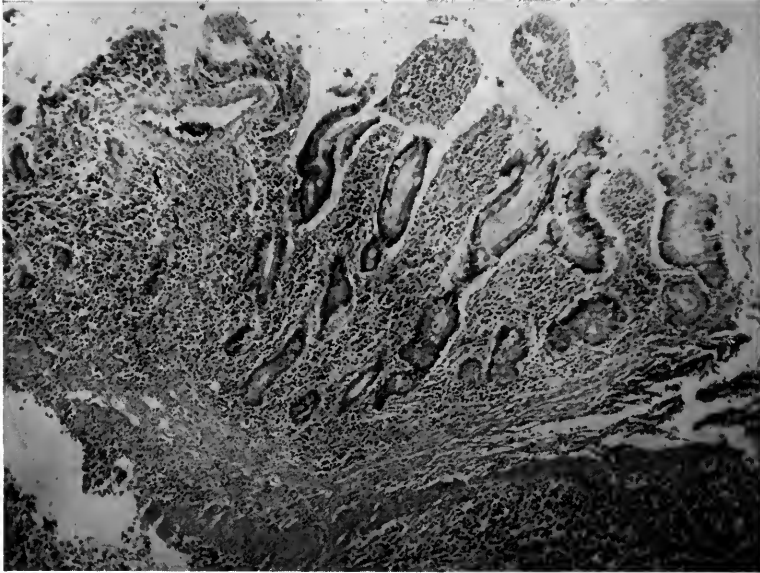


FIG. 3.—A low-power photomicrograph of the tumor in Case I showing the infiltration of the intestine wall by tumor cells.

years. The onset of her present illness was in April, 1921, with severe pain in the epigastrium, nausea and vomiting. This attack lasted four days. Four to five weeks later a similar attack occurred. Pain came on independent of the taking of food and not relieved by food. She belched large amounts of gas. The pain now radiated toward the symphysis pubis.

*Physical Examination.*—Except for the abdomen the physical examination was essentially negative. The point of maximal tenderness was in the region of the gall-bladder. There was moderate spasm of the right rectus muscle in this region. There was no palpable mass in the abdomen. Pulse, respirations and temperature were normal.

*Clinical Pathology:* Urine: amber, cloudy, slightly acid; specific gravity, 1.017, negative for albumin and sugar. The sediment contained a few clumps of pus cells, mucous shreds and squamous epithelial cells. Phenolsulphonephthalein elimination was fifty per cent. in two hours.

*Röntgen report:* The urinary tract was negative for stones. Both kidneys were visible and were apparently normal in size. There was a shadow in the

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region of the gall-bladder, probably due to a thickened gall-bladder wall or stone. The large bowel filled normally, and there were no constrictions or filling defects. The œsophagus was normal, stomach of the 'steer-horn' tonic type, high in position. The outline of the stomach and cap were normal. In six hours time there was a small amount of barium residue in the stomach. The barium was also in the coils of the small intestine. None of the meal had reached the cæcum. In twenty-four hours time the large bowel was apparently negative.

*Course of the Disease.*—After the gastro-intestinal X-ray examination, the symptoms rather suddenly changed and then presented as a case of complete intestinal obstruction. There were obstipation, vomiting of intestinal contents, and general toxic symptoms. Hence an exploratory laparotomy was emphatically advised.

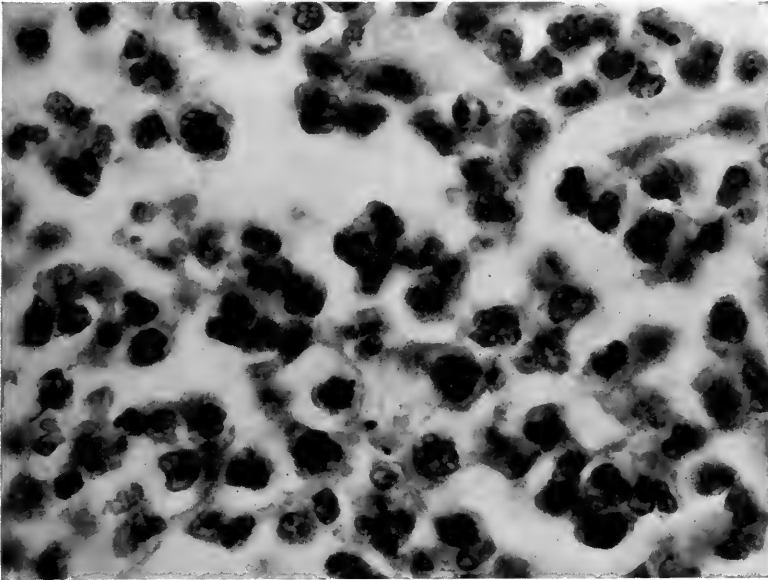


FIG. 4.—An oil-immersion photomicrograph of a field of the tumor in Case I. Several mitotic figures are present. The cells are of practically the same type as in Case II, the formalin fixation being responsible for much shrinkage of the cytoplasm.

Patient was operated on October 8, 1921, under ether anæsthesia and a tumor of the ileum was found about twelve inches proximal to the ileocæcal junction. A loop of the ileum about sixteen inches in length with its corresponding mesentery was resected and a lateral anastomosis of the two ends of the ileum was done. An appendicectomy was also performed. Drainage was instituted. The patient made an uneventful recovery and was discharged from the hospital November 13, 1921. Up to March, 1922, she had had no symptoms of recurrence.

*Pathological Examination.*—The specimen consists of a loop of ileum with part of its mesenteric attachment. It is about forty centimetres in length, six centimetres in diameter at its widest portion, and weighs 410 gms. The middle third of the loop is dilated, this portion measuring about ten centimetres in length, very firm and appears to contain a mass, probably invaginated gut. There are a few fibrous tags attached to the serosa at the beginning of the invagination. Embedded in the mesenteric fat are a few rather firm lymph-nodes, none larger than 0.5 cm. in diameter. A longitudinal incision of the intestine shows the

enlargement of the bowel to be caused in part by an invagination of a proximal into a distal portion of the ileum. The resulting intussusception is irreducible, organization apparently having occurred between the approximating serous surfaces. At the summit of the intussusceptum there is a polypoid mass which is rather friable. It is four centimetres in length and  $2\frac{1}{2}$  centimetres at its base and grayish pink. The polypoid growth occupies nearly the entire lumen, a patency of only 0.3 cm. remaining. The muscular layers of the intestine proximal to the intussusceptum are hypertrophied to about twice the thickness of the intussusciptiens.

*Microscopical Examination.*—Tissue was fixed in Zenker's fluid and ten per cent. formalin. Sections were stained with hæmatoxylin and eosin, phosphotungstic acid-hæmatoxylin and Mallory's aniline blue. The tissue was taken from the polypoid tumor mass and the adjacent intestinal wall.



FIG. 5.—A gross photograph of the specimen from Case II. The polypoid tumor has been opened by a longitudinal incision to show the actual size of the tumor and the extent of the intussusception.

The tumor is composed of broad tracts and narrow cords of polyhedral cells which vary much in size but are as a whole about twice the size of the cells in Case I, about 20 micra. These cells lie irregularly distributed in the tissue spaces and narrow fibrovascular septa constitute the stroma. The cells contain a liberal amount of cytoplasm but the nuclei are also large, often  $\frac{2}{3}$  the size of the cell, and usually lobulated or horseshoe shaped. The nucleoli are very sharply staining and one or two are presented in each nucleus. Numerous mitotic figures are present. There are many multinucleated giant cells and also some polymorphonuclear leucocytes in the outer layers of the tumor. Fibrin thrombi are present in some of the capillaries. There is no epithelial tissue covering the tumor except toward its base. The mesenteric lymph-nodes show chronic lymphadenitis but no malignancy.

*Discussion.*—In the first case a great many preoperative diagnoses were considered. The fact that the patient appeared so well at first, the elusiveness of the tumor mass, and especially the negative X-ray examination, made most

observers hesitate at making a positive statement concerning his condition. There are, however, certain important features in this case, some developing definitely while in the hospital, and which demanded surgical investigation, the impression gaining weight that malignancy of the bowel existed. The symptoms of partial obstruction were almost constantly present, such as the colicky pain, belching of much gas, nausea, vomiting, constipation and repeated findings of occult blood in the stools, also an elusive although ever-present tumor mass in the abdomen.

The second case presents a still more complex picture enhanced perhaps by the region to which the findings pointed. The physical and X-ray examinations suggesting gall-bladder disease and the absence of any palpable tumor gave little aid in determining the condition present. Here again the symp-

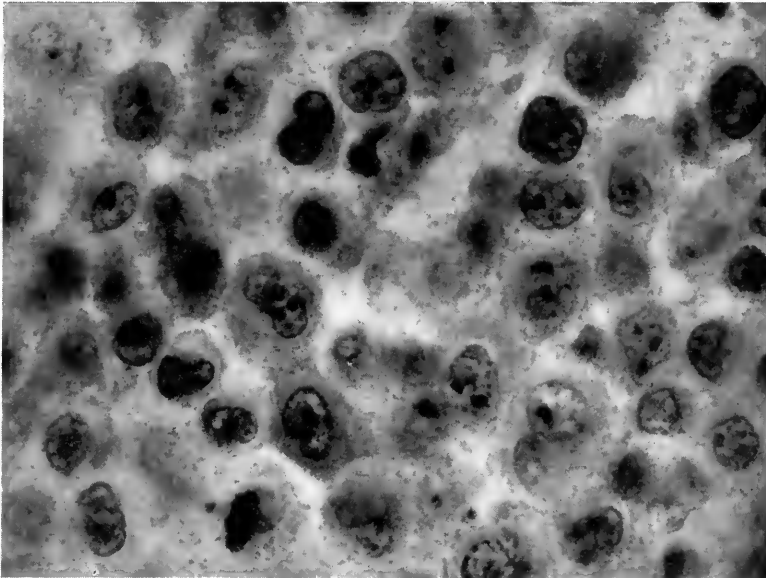


FIG. 6.—An oil-immersion photomicrograph of a field of the tumor in Case II. A mitotic spindle is present in one cell. The character of the nucleus and cytoplasm in these cells is well brought out.

toms of intestinal obstruction led to the advisability of surgery. In this case there was undoubtedly present a chronic intussusception as indicated by the organization found between the serous surfaces of the polyp and adjacent gut. Acute obstruction is very prone to develop in these cases, the active catharsis invariably employed possibly being a factor. Tumors of the intestine are a comparatively frequent cause of intussusception in adults, but occur rarely in infants and children. Of 300 cases cited by Eliot and Corscaden,<sup>3</sup> there were sixty instances of benign tumor type. In almost every case the tumor occupied the apex of the invaginated portion of the gut. By far the most frequent are cases in which the intussusception is preceded by symptoms referable more directly to a malignant stricture.

In both cases the X-ray findings were of little help, the inability to make a positive X-ray diagnosis being due in part to the partial patency of the intestines and also to the absence of any examination of the barium contents of the intestine at the time when it was most probably obstructed by the tumor. It has been suggested by Howard<sup>4</sup> with this last point in mind that X-ray examinations at periods of one to two hours in such cases would help in determining a temporary retardation of the progress of the barium meal.

The diagnosis of lymphosarcoma is rarely made clinically, as the condition is so infrequently met with in the intestine. Ochsner<sup>5</sup> describes the early symptoms as being indefinite abdominal pain, persistent and unrelieved by rest and starvation, colicky and not particularly well localized, often associated with anæmia and cachexia. Like carcinoma, it is often the constitutional effect of the growth that is first noticed, the local signs remaining in the background for a considerable time. There are no certain means of distinguishing between carcinoma of the intestine and lymphosarcoma. Stenosis of the bowel is rare in the latter condition and such occurred in the first case. The obstruction symptoms are due to pressure of the tumor itself or of the involved mesenteric nodes upon the adjacent coils of intestine.

The treatment is removal of the growth, the section in which it originates and any accessible metastases. This procedure may entail the removal of a very considerable length of intestine and it is often a question of judgment whether it should be attempted or not. With the extent of the involvement in the first case, the advisability of surgery might be questioned. However, without radical operation, death would certainly and speedily have come.

The application of radium may prove to be a valuable palliative procedure in these cases. Lymphosarcoma in other regions of the body is to some extent amenable to radiation. If radium exerts a beneficent influence in such regions, it might be used in the post-operative treatment of lymphosarcoma of the alimentary tract, but the difficulty of making a preoperative diagnosis and the development of a suitable technic of application will long be serious obstacles. Bloodgood<sup>6</sup> says: "The one lesion of which, as far as I know, surgery has never accomplished a cure, is lymphosarcoma of the lymph-glands, and apparently radium has done so. Therefore, as soon as this diagnosis is suggested and established, radiation should be given, and continued at intervals." This statement offers more relief to the patient than most experience leads one to expect, and the difficulty of barring radium rays from such vital tissues as the adrenals will probably long be a great drawback to intra-abdominal radiotherapy.

Lymphosarcoma of the alimentary tract probably arises as a rule from the lymphoid cells of the mucosa, but there are many types of these cells in the small intestine. Bunting and Huston<sup>7</sup> showed that the lymphocytes in the blood stream migrate into the mucous membrane of the gastro-intestinal tract, and apparently there, and in the intestinal lumen, the function of the lympho-



## LYMPHOSARCOMA OF THE INTESTINE

cyte is normally performed. Jacobson<sup>8</sup> has suggested that the lymphoid cells which are very capricious and unstable may in response to some irritant, possibly infectious, acting over a considerable period or in a specific manner, be influenced to a lawless proliferation. It is often difficult to make a distinction between lymphosarcoma of the gastro-intestinal tract and some of the infectious granulomata found there.

In the tumors upon which this study is based the predominant cell is one of the size of the transitional leucocyte of the blood and with a lobulated or horseshoe-shaped nucleus. The other cells were large and small lymphocytes and eosinophiles.

### CONCLUSIONS

1. Two cases of lymphosarcoma of the intestine are described, one of tumor of the jejunum, the other of the ileum. In one instance the tumor was a diffuse infiltration of the intestinal wall, an annular type of growth. In the other case a lymphosarcomatous polyp was found which gave rise to an intussusception.

2. The microscopic picture leaves much speculation as to the origin of the tumor cell, but in these two cases the predominant cell is one which resembles a great deal the transitional large mononuclear cell of the blood.

3. Lymphosarcoma of the intestinal tract is difficult of clinical diagnosis, the signs being simply those of malignancy, with partial obstruction being rather constantly present. X-ray examination was of no help in these two cases.

4. Treatment consists of radical removal of the primary growth with as much of the metastases as is possible. Improved methods of radium application might be a valuable therapeutic adjunct.

5. Chronic irritation, possibly a specific toxin, may play an important rôle in the genesis of lymphosarcoma. The histology of infectious granulomata of the intestine often simulates this tumor. Perhaps lymphosarcoma is only one of the many bizarre late pictures of lesions which were at one time of the nature of Hodgkin's disease or lymphoblastic or lymphocytic aleukæmia.

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# METAPLASIA IN OVARIAN DERMoids AND CYSTADENOMAS

## REPORT OF THREE CASES

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THE relation of metaplasia to neoplastic pathology was studied and discussed by Lubarsch, in 1901, and he mentioned several examples, among them a squamous-cell epithelioma of the gall-bladder. He asserted that there is no squamous epithelium in the gall-bladder, bile ducts, or neighboring structures and concluded that such an epithelioma probably results from

metaplasia of the lining cells of the organ. Two of the three cases herein reported are typical of metaplasia in ovarian dermoid cysts and one is a papillary cystadenoma.

### CASE I (A8536).

—Mrs. C. E., aged fifty-eight years, a widow, and the mother of four children, was examined in the Clinic, April 6, 1908. She complained of a small "lump" in the left side of the abdomen accompanied by a "burning and drawing sensation" of five months' duration.

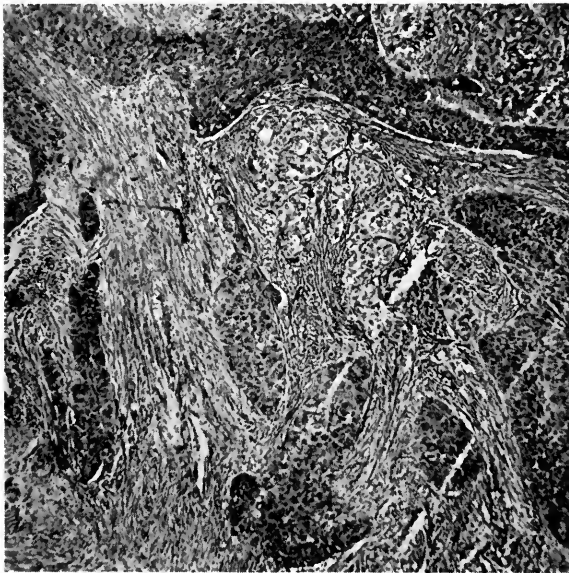


FIG. 1.—Epithelioma. In certain areas the cells are not differentiated and show evidence of rapid growth (X50).

Four months before there had been blood in the stool. In the last few months she had felt weak, lost fifteen pounds in weight, had increasing constipation, and noticed a gradual enlargement in girth. Fourteen months before, a cyst of the right ovary had been removed elsewhere and the pathologist had reported it to be a dermoid cyst with beginning malignancy.

Dr. W. J. Mayo resected the sigmoid which was involved by a malignant neoplasm; the tumor consisted of a papillary epithelioma

(Figs. 1 and 2) which had apparently arisen from the dermoid cyst previously removed and had involved the sigmoid secondarily. The patient died about nine months after the last operation.

CASE II (A380815).—Mrs. B. H., aged sixty-seven years, the mother of six children, came to the Clinic January 3, 1922, complaining of a gradually increasing swelling of the abdomen. Following the appearance of the tumor she had had a burning pain in the right lower abdominal quadrant. Her health had been only fair for eight or ten years. Headaches, abdominal heaviness, and belching following meals distressed her greatly.

At examination a large, hard abdominal tumor was found, which extended to about 4.5 cm. above the umbilicus.

At operation Dr. E. S. Judd found a large cyst of the right ovary filling the pelvis and much of the peritoneal cavity. The uterus, left tube, and ovary were grossly unaltered and were not disturbed. A large dermoid cyst, weighing 4800 gm. and containing sebaceous material and hair, was removed. On the inside of the cyst was a grayish-brown papillary mass, 4 cm. in diameter, projecting into the cavity from 1 to 3 cm. (Fig. 3). Microscopically the growth was a papillary squamous-cell epithelioma (Figs. 4 and 5).

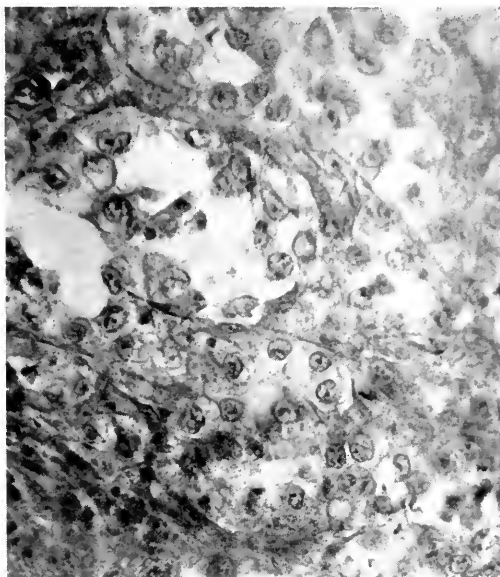


FIG. 2.—Higher magnification of area shown in Figure 1 (X200). Note the undifferentiated malignant cells.

CASE III (A115369).—Mrs. S. D. F., aged forty-six years, came to the Clinic in 1914, complaining of long-standing menorrhagia and pain, of about four months' duration, in the right lower abdominal quadrants. She had never borne children.

On examination a movable abdominal tumor was found which reached a little above the umbilicus.

At operation Dr. W. J. Mayo found a cyst of the right ovary about as large as a seven months' pregnancy. The specimen removed consisted of the uterus, tubes, and ovaries. The uterus contained multiple subserous and interstitial fibromyomas, the largest 2 cm. in diameter, the smallest 5 mm. There were adhesions between the right Fallopian tube and the cyst; the left tube apparently was unaltered, the left ovary was small, atrophic, gray, and fibrous. The right ovary was a large cyst, containing multiple papillomas scattered over the inner surface of

the wall, the largest being 7 by 5 by 3 cm. and the smallest 5 mm. in diameter (Fig. 6). Microscopically, the tumor was a papilloma covered by columnar epithelium, typical of papillary cystadenoma of the ovary (Figs. 7 and 8).

For seven years the patient was in fairly good health. She returned to the Clinic, December 13, 1921, because of frequent, burning and difficult urination and a definite sense of obstruction in the rectum and vagina.

Examination revealed a movable, hard, abdominal tumor pressing on the urinary bladder and rectum, coming well up to the umbilicus.

At the second operation a pelvic cyst about as large as a six months'



pregnancy was found; the cyst was adherent to the intestines, abdominal wall, sigmoid, omentum, and right ureter. The tumor contained serous fluid and in one area, on the inside, there was a firm, raised, flat, grayish-brown mass, covering a surface 1.5 by 1 cm. and projecting into the lumen 2 to 3 mm. (Fig. 9). Histologically, this tumor was composed of epithelial cells

growing from the cyst wall in the manner and form of a squamous-cell epithelium, in places showing definite keratinization (Figs. 10 and 11). The whole neoplasm probably arose from a cystic remnant of the papillary ovarian cystadenoma which ruptured during removal at the former operation.

Peters, Weiner, Williamson and Barris, and others, including Frankl, have reported cases similar to Cases I and II, but in a survey of the literature we have been unable to find a report of a case similar to Case III.

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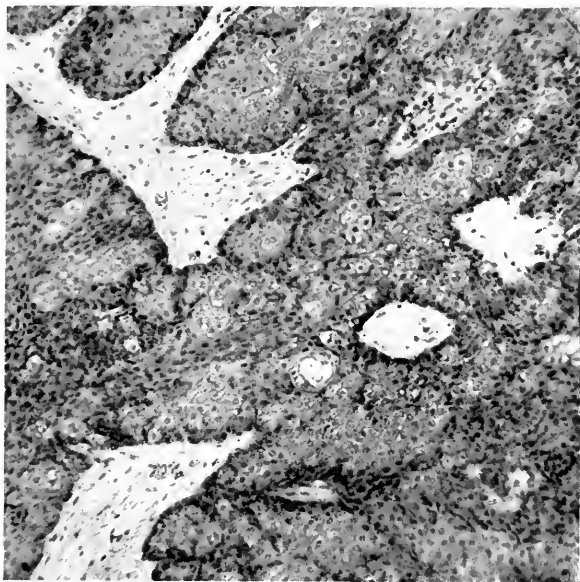


FIG. 4.—Squamous-cell epithelioma. Areas of the section show slight keratinization (X100).

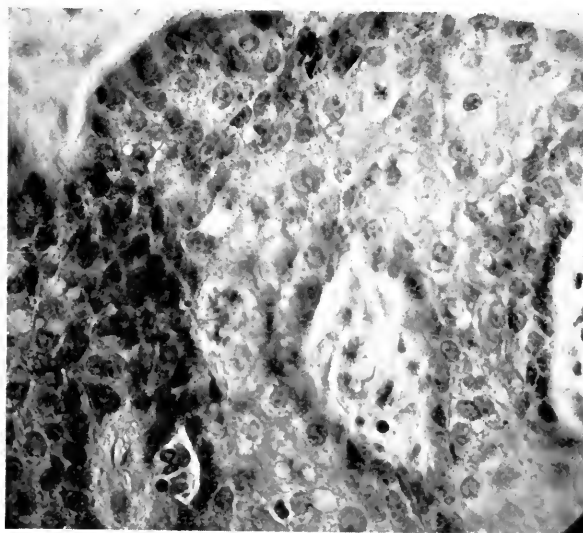


FIG. 5.—Detail of the malignant cells of epithelioma (X350).



FIG. 6.—The inside of the ovarian cyst showing the papillary tumor.

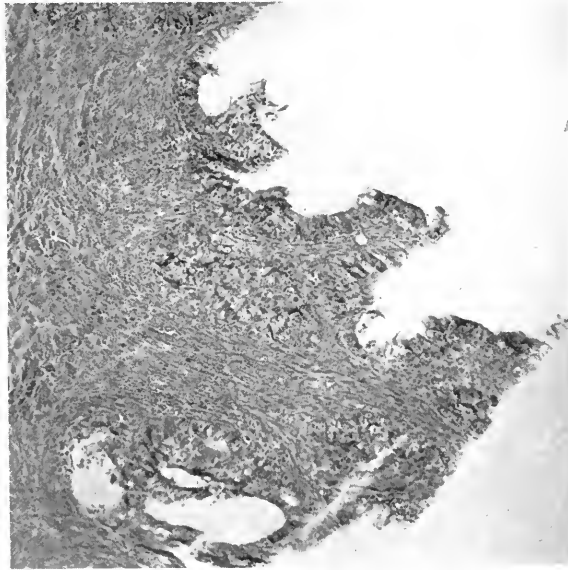


FIG. 7.—Typical papillary cystadenoma of the ovary (X50).

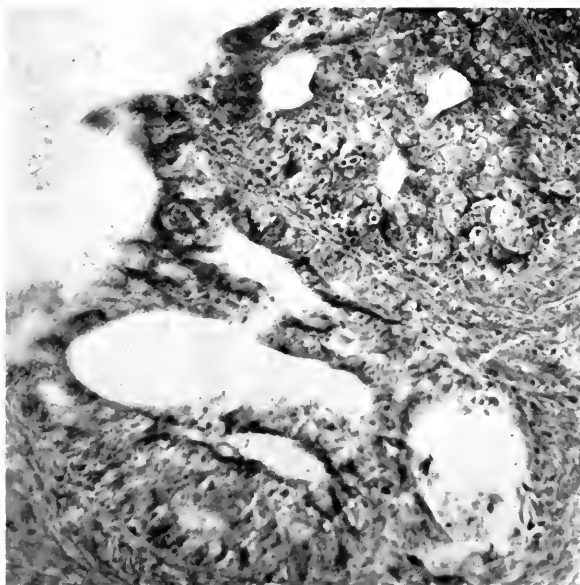


FIG. 8.—Epithelial cells covering the tumor (X120).

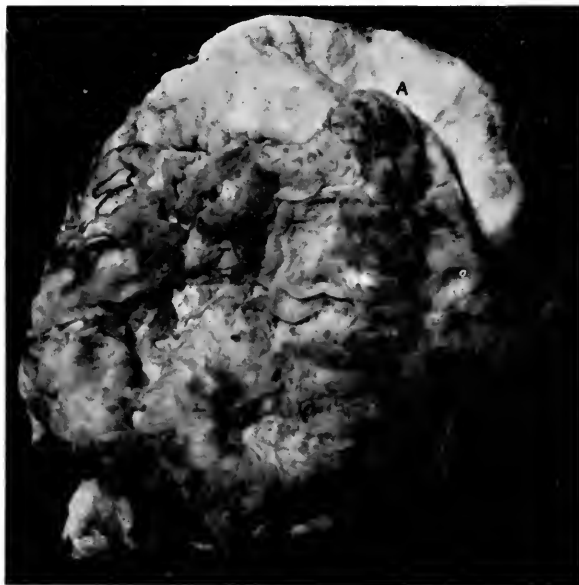


FIG. 9.—Inside of the ovarian cyst showing the raised epithelioma at A.

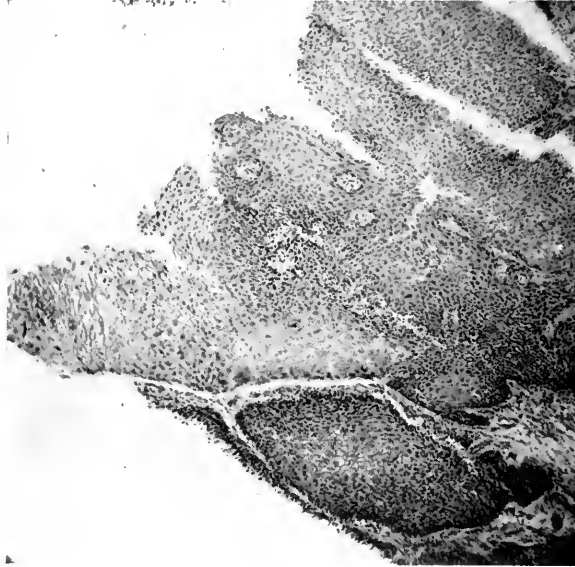


FIG. 10.—Typical squamous-cell epithelioma showing definite keratinization near the centre (X75).

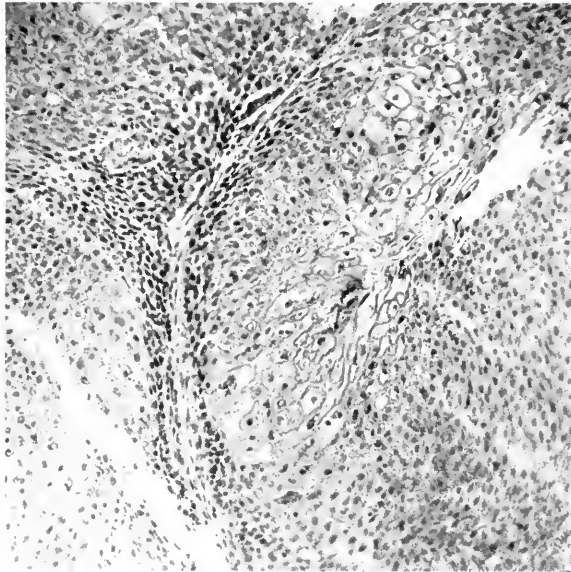


FIG. 11.—Details of the tumor, especially the differentiation of cells (X100).



## METAPLASIA IN OVARIAN DERMoids AND CYSTADENOMAS

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## PRIMARY TUMORS OF THE URETHRA

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ENGLISCH cites Gurlt's statistics from the Vienna Clinics to illustrate the rarity of primary carcinoma of the urethra. In one series of 16,637 cases of tumors of various organs, no instance of malignant growth of the urethra was noted; in another series including 4000 cases of disease of the male urinary organs only three were of carcinoma of the urethra. In 358 cases of carcinoma of traumatic origin collected by Löwenthal there were two of carcinoma of the urethra. The occurrence of benign solid tumors in this region is even more rare.

Five cases of solid tumor occurring primarily in the urethra have been treated at the Mayo Clinic. One of these was benign, the other four were malignant. Most malignant growths of the urethra are of epithelial origin and, similar to epithelial tumors elsewhere, trauma and irritation are important etiologic factors. The clinical course of tumors of the male and female urethra differs markedly.

*Epithelioma of the Male Urethra.*—The prostatic urethra is lined by epithelium similar to that of the bladder. The mucosa of the anterior urethra is more flat and compact than that of the prostatic urethra and in the fossa navicularis is definitely squamous cell in type.

Inflammatory irritation not uncommonly causes metaplastic changes on epithelial surfaces. Bohm describes metaplasia of the intestinal mucosa; Deetz notes the same condition in the gall-bladder, as does Hallé in the renal pelvis and ureter. Similarly chronic infection and irritation are important factors in the production of neoplastic changes in the urethral mucosa. Wassermann and Hallé, and Cedercreutz have described a state of epidermization of the urethral epithelium due to urethral infections. Dittel and Kaufmann<sup>28</sup> also demonstrated definite epidermization associated with urethral stricture. The forceful flow of infected, irritating urine through the narrow cicatrized passage and the frequent traumatic dilatation with instruments produce a protective hyperplastic reaction. Thiersch was the first to call attention to the malignant transition of these cicatrized, thickened areas. He reported a case of squamous-cell epithelioma developing on a long-standing stricture. Posner, in 1904, collected twenty cases of primary carcinoma of the male urethra; twelve of the patients had previously had

urethral strictures. When these tumors develop following long-standing infection and stricture they have a structure similar to that of tumors forming on other squamous-cell surfaces. In most cases the irritation of the growth quickly causes symptoms and leads to an early diagnosis.

In some cases urethral carcinomas are preceded by long periods of urinary difficulty and irritation. The tumor formation is somewhat analogous to the long-standing premalignant stages preceding the development of squamous-cell tumors of the urinary bladder. König reported a case of urethral carcinoma developing after urinary obstruction of forty-eight years' duration, and Oberländer noted a somewhat similar case developing after forty years of urinary difficulty. Not all urethral carcinomas are preceded by long-standing urinary trouble; in young persons the onset is sometimes quite rapid. Hutchinson noted a case of a man who had had only three weeks of obstruction and pain before a definite area of malignancy was discovered. Albarran reported a patient who had symptoms of only six months' duration. Barney and Fuller both reported cases of sudden onset with acute retention. Schustler reported a case of acute retention with fourteen days of uræmia, followed by death.

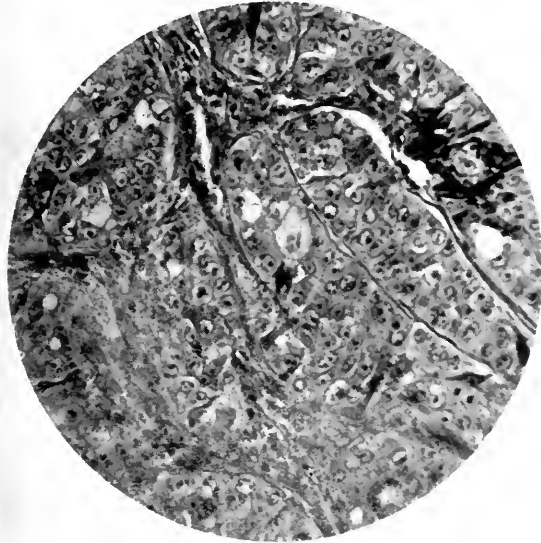


FIG. 1.—(Case 211630.) Epithelioma of the male urethra. Highly cellular structure with moderate fibrosis (X180).

Traumatic strictures in some cases have the same malignant potentialities as those of infectious origin. Trzebicky reported a case of squamous-cell carcinoma developing on a traumatic stricture of ten years' duration. Witsenhausen reported the case of a man who developed a traumatic urethral stricture following a blow on the penis. The stricture persisted thirty-eight years before malignant changes occurred. Löwenthal cited a similar case of a man kicked in the perineum; a traumatic stricture formed and after thirty years of urethral obstruction malignancy developed in the region of the scar. Soubeyran noted the case of a man of sixty-four, a sex pervert, who developed a squamous-cell carcinoma of the urethra after frequent instrumental urethral manipulations.

The majority of carcinomas which follow long-standing infection and trauma are in men of the cancer age and commonly occur at the usual site

of stricture formation, in the cavernous and membranous urethra. Occasionally they occur in the penile urethra, and but rarely in the fossa navicularis. Of forty-two cases of carcinoma of the male urethra collected by Preiswerk, thirty-eight were in the membranous or cavernous urethra.

Most of these tumors have a histologic structure similar to that of squamous-cell epithelioma of the penis, though of a higher degree of malignancy. There is moderate hyalinization and pearly body formation, but rarely so extensive as in the uncommon and histologically similar tumors located in the bladder. In most cases there is an extensive lymphocytic infiltration and the masses of tumor cells are walled off by fibrous tissue. Metastatic growths, which are not common, have the same tendency to remain



FIG. 2.—(Case 211630.) Highly malignant cells with prominent nucleoli. Tendency toward epithelial pearl formation (X 500).

localized in the primary glands as do those arising from epitheliomas of the penis. In young men the carcinoma is more likely to be papillary than squamous-cell, and the long premalignant period of trauma and infection is generally absent. Papillary carcinomas in most reported cases were extremely malignant; they rapidly infiltrated the surrounding tissues and metastasized freely. Hutchinson reported the case of a man, aged twenty-two years, with a papillary carcinoma of the urethra; ulceration through the body of the penis occurred three weeks after the onset of the swelling and obstruction. Six weeks after the first symptoms the regional glands were involved. Bosse reported a similar case in a man, aged twenty-five years, who had involvement of the inguinal glands after only a few months of symptoms. Following incision, the growth spread to the retroperitoneal glands and death occurred several months later. In these rapidly growing carcinomas in young men the tumor is not infrequently in the anterior urethra. Ottow noted a case in a man of thirty-three, with an extensive carcinoma completely filling the fossa navicularis; the growth had developed after a period of only four weeks of urinary difficulty. Similar tumors of the fossa navicularis were also reported by Lécene, Scott and Fuller. Squamous-cell tumors of a moderate degree of malignancy are also occasionally seen in this location although they generally occur in old men. Ménard

## PRIMARY TUMORS OF THE URETHRA

reported a case in a man, aged fifty-seven years, and Shattock a case in a man, aged fifty-four years.

Malignant disease of the male urethra is not uncommonly associated with urinary sinuses, which generally result from urinary obstruction and extension of the malignant process. Gayet, Lavenant, König and Röpke all reported cases of this type. In a small number of cases the formation of the fistula is possibly one of the determining factors in the development of malignancy. The irritation of the urine on the cutaneous border and along-standing, low grade infection tend to induce a protective hyperplastic reaction in the epithelial margin. The cell structure in these irritated areas at times approximates the histologic formations seen in low grade epitheliomas. Paget, Orth, and Guiard have called attention to the epithelial transition which takes place in old fistulas and sinuses. Poncet reported two cases of carcinoma developing in a fistulous tract. The first was in a man who in early life had had chronic urethritis; following urethral dilatation a peri-urethral abscess developed; this was incised and a fistula formed which drained for sixteen years. A malignant process developed around the fistulous tract with rather sudden onset of symptoms.



FIG. 3.—(Case 112110.) Squamous-cell carcinoma of the urethra; slight hyalinization and marked fibrosis (X 70).

In the second case the carcinoma developed on the border of a perineal sinus six months after incision of a peri-urethral abscess. Guyon noted the case of a man who developed a carcinoma of the urethra following chronic urethritis and multiple fistulas of ten years' duration. Englisch cited a case in which peri-urethral abscess and fistula drained three years and was followed by the development of malignancy. The case of a man with carcinoma of the urethra which followed a long-standing urethral stricture is reported herewith:

CASE A211630.—Mr. G. T., aged forty-eight years, came to the Clinic, October 23, 1917. In his youth he had an infectious urethritis and for twenty years a urethral stricture requiring frequent dilatation. He had a set of urethral sounds which he used often. For three months, he had had difficulty in keeping the urethra

open, and had noticed a gradually increasing swelling of the perineum. His general health was good.

A hard nodular mass, 2 cm. in diameter, was found in the perineum at the penoscrotal angle. The urethra was markedly obstructed in the region of the mass, but it was possible to pass a filiform bougie to the bladder. The stricture was dilated several times but rapidly recurred, finally producing almost complete obstruction.

At operation a growth 4 cm. long was found at the juncture of the membranous and anterior portions of the urethra. The involved area was completely excised. Later, complete emasculation of the penis and testicles with dissection of the inguinal glands was advised, but refused by the patient. The portion of the urethra removed contained an irregular firm tumor, about 3 cm. in diameter. Histologically, the tumor was made up of masses of large epithelial cells with only

a small amount of supporting tissue. The cells were large and irregular in size, and contained large nuclei and prominent nucleoli. There was slight cellular hyalinization and a few small epithelial pearls. Atypical mitotic figures were common and there was an extensive fibrosis and round-cell infiltration. The growth was a well-localized squamous-cell epithelioma of a high degree of malignancy. (Figs. 1 and 2.)

Six weeks later the urethra was reconstructed from a section of the internal saphenous vein. Two months later the area had completely healed, save for

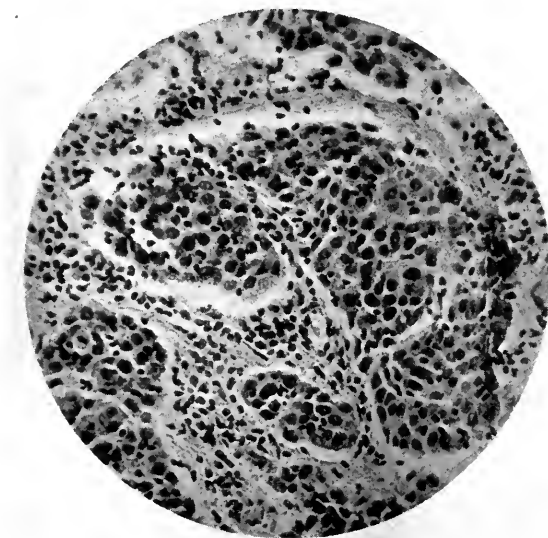


FIG. 4.—(Case 262718.) Mass of malignant cells from urethral tumor. There is no tendency toward hyalinization or pearly body formation (X 180).

a persistent perineal sinus. Three hundred fifty milligram hours of radium were applied to the urethra in the region of the scar through the perineal sinus.

The patient was alive at the end of five years. Whether or not there had been recurrence was not ascertained.

*Epithelioma of the Female Urethra.*—Primary carcinoma of the female urethra is occasionally confused with carcinoma of the vulva and vaginal wall, especially in the later stages. Many of the cases reported as carcinoma of the urethra in reality belong to the group of vulvo-urethral tumors. Various reports of collected cases have been published, especially those of Ehrendorfer, Vineberg, and Percy. In 1912, Whitehouse collected forty-three authentic cases from the literature. Thirty-two of these were of the vulvo-urethral type; the other eleven were primary urethral tumors. The

vulvo-urethral tumor is generally papillomatous and fungating and often starts on the urethral margin as a small hard nodule. Primary carcinoma of the urethra in most cases develops in the mucosa.

The majority of malignant tumors of the female urethra are squamous-cell carcinoma of a somewhat higher type of malignancy than histologically similar tumors occurring on the cutaneous surfaces. They generally respond readily to radium radiation.

Ehrendorfer holds that local inflammatory processes are predisposing factors in the etiology of these growths. Hallé described a leukoplasia of the urethra resulting from protracted urethritis as a possible precursor to malignancy, similar to premalignant conditions in the male urethra.

Whitehouse divides epithelioma of the female urethra into two types, first, an irregular elongated ulceration involving only the mucous membrane of the urethral floor, usually occurring in the distal segment, and second, a peri-urethral indurated tumor with a tendency to involve surrounding tissue extensively and occlude the urethral canal.

In the first type the growth is generally of a high degree of malignancy with only slight cellular differentiation.

In the second type, the prognosis is more favorable; ulceration occurs late and fibrosis and hyalinization are prominent features. In some cases the growth is polypoid, a red fungating mass which may be pedunculated and protrude from the urethra. The primary neoplasm may grow very slowly and cause only a few symptoms, as sometimes occurs in carcinoma of the prostate. Attention may be directed to the primary focus only by finding a metastatic growth.

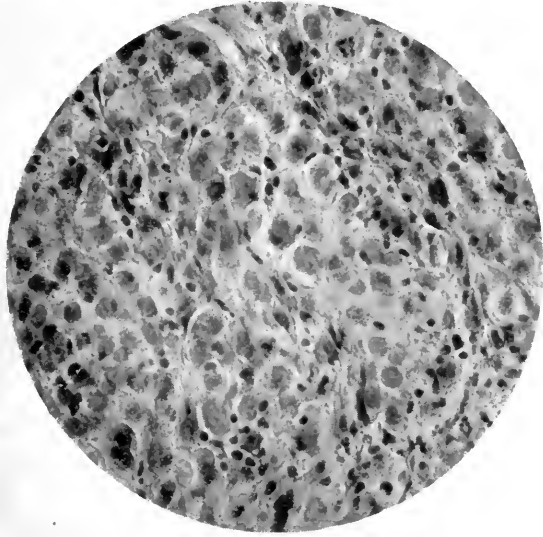


FIG. 5.—(Case 262718.) Irregularity of size of malignant cells together with marked lymphocytic infiltration (X500).

#### THREE CASES OF PRIMARY URETHRAL CARCINOMA IN THE FEMALE

CASE A112110.—Mrs. M. B., aged forty-four years, came to the Clinic, August 4, 1914. Twelve years before several small tumors had been removed from the meatus with the cautery, since then she had had moderate dysuria and frequency of urination. Sixteen months before her home physician had noticed three small nodules protruding from the urethra and had removed them; this was followed by occasional slight bleeding from the urethra and painful urination.

On examination a hard, ulcerated, nodular growth was found protruding from the urethral orifice and involving the outer half of the urethral canal. On cystoscopic examination the bladder, internal sphincter, and internal half of the urethra were found to be normal. A specimen removed for diagnosis revealed a squamous-cell epithelioma with only slight hyalinization and rare pearly-body formation; there was marked fibrosis and an extensive lymphocytic infiltration. (Fig. 3.)

The growth and the external urethra were charred with the Percy cautery. The wound healed promptly. Six months later a small, hard, nodular growth protruded from the urethra and was cauterized with the Percy cautery. In four months there was another small growth, to which a 22 mg. capsule of radium was applied in four periods of fourteen hours each. Only a slight reaction followed the treatment and the growth disappeared rapidly.

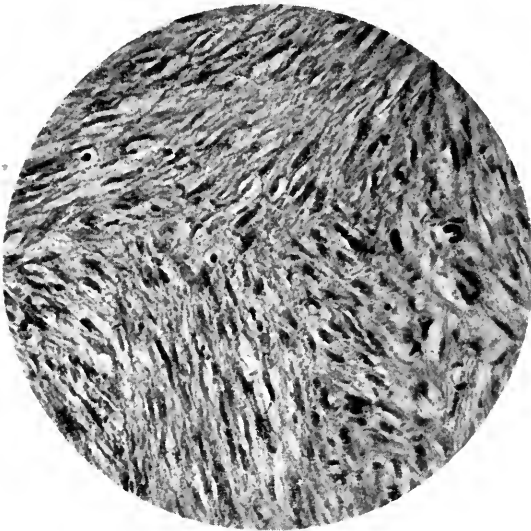


FIG. 6.—(Case 60418.) Fibroma of the urethra (X180).

Examination revealed a tumor 2 cm. in diameter in the middle urethra. On cysto-urethroscopic examination, a nodular, firm growth was found to involve the entire right wall and a part of the left wall of the urethra, extending almost to the orifice. The bladder was not involved. On microscopic examination of an excised specimen the tumor was found to be epithelioma. The cells were markedly irregular in size; some were enormous. No pearly bodies and very little hyalinization was seen. There was moderate fibrosis and an extensive lymphocytic infiltration (Figs. 4 and 5). The case was not considered satisfactory for surgical treatment. Two hundred milligram hours of radium was applied to the vulva in two doses one week apart. Three months later 2000 mg. hours was applied to the urethrovaginal orifice in three applications one week apart.

Six months later the patient was apparently in good health although she had lost 30 pounds. The urethra was indurated and there was some peri-urethral thickening. Masses could be felt in both lower abdominal quadrants. The vagina was negative. Cystoscopic examination at this time, one year after the first

The patient was without recurrence and perfectly well six years later.

CASE A262718.—Mrs. G. F., aged fifty-three years, came to the Clinic, March 5, 1919. Nine months before she had noticed enlarged, hard inguinal glands on the left side. They grew rapidly, and were removed three months before. One month before she had noticed a small mass in the urethral orifice, and soon after dysuria and perineal irritation appeared. The urethral mass increased slowly in size.



## PRIMARY TUMORS OF THE URETHRA

examination and fifteen months after the first onset of symptoms, showed the tumor still present in the urethra and an extensive involvement of the anterior wall of the bladder. The growth was obviously inoperable. Two hundred milligram hours of radium was applied to the posterior urethra and anterior bladder wall. The patient died six months later. Necropsy was not obtained. Until shortly before death she had only moderate urethral irritation although she complained at times of severe abdominal discomfort. The radium undoubtedly delayed an extension of the malignant process and by partial relief of the local condition prevented obstruction of the urethra. The case is of interest in that it shows an extension of the process internally to the bladder. The majority of these growths extend outward and later involve the vulva. On the other hand the urethral mucosa has an unusual resistance to invasion of tumors from other areas. Vesical tumors, even when extensively involving the bladder mucosa, practically never extend into the urethra.

CASE A319698.—Mrs. E. W., aged thirty-four years, came to the Clinic, June 14, 1920. Eighteen months before she had had a miscarriage; since then she had been troubled with frequency, bleeding, and leucorrhœa. Three months before her doctor had found a growth about 3 cm. in diameter protruding from the urethra. This growth had been removed six weeks before and on microscopic examination was found to be malignant. The frequency and dysuria had moderated, and urethral bleeding was occasional and slight.

The urethral opening was slightly reddened. Two small tags projected from the right urethral wall near the external outlet. These tags were removed and examination showed the growth to be an epithelioma. The inguinal glands were enlarged (about 1 cm. in diameter) on both sides.

Two hundred milligram hours of radium was applied to the urethra and 800 mg. hours to both the right and the left groin. In three months the urethra was clear but the enlarged glands persisted. Five hundred milligram hours of radium was applied to both inguinal areas in six applications. Eleven months later the patient's urethra was negative and there were no palpable glands. Her general health had improved considerably.

*Adenocarcinoma.*—Whitehouse asserts that urethral adenocarcinoma in the female originates in the peri-urethral glands, and that it is analogous to prostatic carcinoma in the male. Most of the few cases reported occurred in young persons. The tumors are of about the same degree of malignancy as the urethral epitheliomas. Lockyer removed a glandular malignant area 1 cm. in diameter which was attached by a wide base to the urethral floor in a female. There was no recurrence at the end of two years. McMurty reported two cases of adenocarcinoma of the urethra; one in a woman of forty-seven who had a recurrence twelve months after removal, the other in a woman of twenty-six; this patient was free from recurrence one year after a radical excision of the growth. Battle removed the urethra completely for extensive adenocarcinoma in a woman of fifty-eight. The neck of the bladder was closed and a suprapubic drainage established.

Glandular types of malignancy are seldom observed in the male urethra. Oliver and Clunet reported the case of a man of fifty-two with a small nodular adenocarcinoma 3 cm. from the meatus. Two years later the mass had ulcerated through the corona and extensively involved the glands. Usually the growth appears in the glands at the base of the penile urethra

and may be confused with primary urethral tumors. Such extra-urethral tumors cause fewer symptoms; they grow more slowly and generally attain a large size before pain or urinary symptoms develop. They have a tendency to recur after removal. They may completely surround the urethra but they rarely involve the urethral mucosa. Paquet and Herrmann reported a case of a man of sixty-five who for two years had a small mass between the bulb of the urethra and the rectum. The mass was removed and a tumor developed in Cowper's gland. Kocher noted the case of a man with a similarly located tumor. After four years of growth the tumor was excised but recurrence followed rapidly. Pietrzekowski reported the case of a male aged nineteen years with a tumor of Cowper's gland of enormous size. Rapid recurrence followed removal in this case also.

*Sarcoma.*—Sarcomas similar to connective tissue tumors in other parts of the body are most common in young persons. They may be pedunculated, and in the female often protrude from the urethra. They grow rapidly, metastasize extensively, and offer the patient a very poor prognosis. Maria-chess reported a case in a man aged twenty-two years, of a mass in the penis which rapidly increased in size; four months after the onset, the growth caused complete obstruction. Mark observed a case in a man aged twenty-four years. The growth was in the anterior urethra and caused severe dysuria and terminal hematuria. Several months later the whole urethra was involved. Kaufmann<sup>27</sup> reported the case of a spindle cell sarcoma occurring in a man aged fifty-five years, and Albrecht, a case of pigmented sarcoma in a man, discovered at necropsy.

Melanotic sarcoma occasionally occurs in the female urethra. It is extremely malignant and involves surrounding tissue extensively. Reed observed abdominal metastasis seven months after the removal of a pigmented urethral growth from a woman of sixty-four. Mundel reported a case of melanotic sarcoma which projected from the urethral orifice; the patient died eight days after operation from pneumonia. Watson noted a case of inoperable myxosarcoma which grew from the urethral orifice; the patient died four months later. Cases of spindle-cell sarcoma occurring in women are reported by Hirst and McWeeney.

*Angioma.*—Angiomas are found more often in the male than in the female, and in the young person. Only a few cases are reported, and undoubtedly some of them, as Rokitsky holds, are more representative of simple hypertrophy of vascular segments than of neoplastic overgrowth. They have a tendency to bleed freely; they cause little pain or urinary discomfort, and in most cases respond readily to fulguration. Forgue and Jeanbrau report the case of a boy fourteen years who had an abundant painless urethral hemorrhage. On urethroscopic examination a large irregular angioma was found filling the posterior urethra. The mass disappeared completely after repeated fulguration, leaving a urethra of normal elasticity. Wolf and Seifert both report similar cases successfully treated by fulgura-

tion. Similar to other connective-tissue tumors of the urethra, angioma may be pedunculated. Petit noted a small angioma in a woman which as a result of repeated straining had been partly forced from the urethra. It was attached by a long narrow pedicle to the urethral mucosa. Banzet removed a small angioma from the upper wall of the urethral canal in a female; the tumor recurred rapidly.

*Fibromyoma.*—Fibrous nodules are often found in the prostatic urethra in men over fifty; they are only rarely seen in the penile urethra. Halstead reported the case of a man of twenty-four with a small mass in the anterior urethra. In six months the growth obstructed the urethra. It was about 2 cm. in diameter, freely movable, and only slightly sensitive. At operation it was found to be attached to about three-fourths of the urethral circumference. Histologically it was a true fibroma.

Fibromyomas occur more often in the female urethra than in the male. In the female they may be attached to any part of the urethra, but usually to the posterior half. They are generally covered with urethral mucosa, small, and cause but few symptoms. They are unattached to the peri-urethral tissues, and shell out readily at operation. They bleed only slightly and offer very little obstruction to the urinary stream. They may grow rapidly and attain an enormous size. If they are large they are usually attached to the urethra by a pedicle. Tumors of this type are reported by Temoin and Höning. In Höning's case the tumor was 30 cm. in diameter and was connected with the urethra by a long narrow pedicle. The whole mass rested on the vaginal outlet. Wetherill reported the case of a woman with a slow growing fibroma of twenty years' duration. The patient desired operation only when the tumor interfered with walking. The growth was a pure fibroma. The large fibromyomas often show areas of degeneration and ulceration. Labhardt reported a case of a calcified fibromyoma in a woman of sixty-three. In an occasional case recurrence is early and extensive. Benoit excised a fibroma from the urethra of a woman of thirty-nine; three months later there was a large secondary growth. Histologically, the majority of these tumors are fibromas or fibromyomas. True myomas, for example those reported by Kretschmer and Büttner, are unusual.

#### FIBROMA OF THE URETHRA

CASE A60418.—Mrs. F. E., aged twenty-six years, came to the Clinic, October 23, 1916. For twelve months she had noticed a small mass in the region of the urethra which had increased gradually in size. There had been no urinary disturbance, but straining often made the growth bleed, and at times the urine spat-tered. During the last four months, she had had slight vaginal bleeding between her menstrual periods.

Examination showed a nodular reddened mass 3 cm. in diameter protruding from the urethra. A diagnosis of benign tumor of the urethra was made.

At operation an irregular lobulated mass attached by a broad base to the outer half of the urethral mucosa was dissected from the urethral canal. About one-third of the growth protruded from the urethral orifice. The specimen removed was firm and nodular and covered with urethral mucosa.

Histologic examination showed the mass to be made up almost completely of fibrous tissue; no myomatous tissue was found (Fig. 6). In some areas interlacing fibrous strands separated the growth into numerous small spaces, some of which were filled with a thinly cellular collagenous material not unlike a mucous polyp.

Three years later the patient had not had a recurrence and was in good health.

*Polyps and Papillomas.*—Polyps and papillomas of the urethra are often seen. The majority are minute and are usually the result of long and tedious urethral infections. They have very little clinical significance. In most cases they disappear following treatment of the underlying infectious condition. In the male urethra the small growths usually occur in the region of the verumontanum and the internal sphincter. When located in the region of the verumontanum they may be associated with various sexual and neurasthenic disorders. Both the small and the large tumors respond readily to fulguration or snaring. Those occurring in the posterior urethra of the male may be pedunculated and occasionally interfere with the closure of the internal sphincter; those occurring near the external orifice are generally flat and sessile. Multiple and extensive growths are occasionally seen. Morrow reported a case of multiple polyps in a male urethra causing almost complete obstruction. The urethra behind the mass of polyps was tremendously dilated. Zuckerkandl reported a case in which a papillomatous growth covered the entire urethra. There is a tendency to rapid and extensive recurrence after removal. Elder and Lewin both reported cases in which the recurring papilloma completely filled the urethra.

#### SUMMARY

Malignant tumors of the male urethra often develop following long-standing urethral infections. Primary tumors are extremely rare both in the male and female. In the female they are generally located in the anterior urethra and tend to grow outward, away from the bladder.

Most malignant tumors of the urethra are squamous-cell growths. They are highly malignant but are well walled off by fibrous tissue and lymphocytic infiltrations. They tend to remain limited to the local condition and to the regional lymph glands and usually respond readily to radium treatment.

Three cases of epithelioma of the female urethra and one of the male urethra are reported from the Mayo Clinic.

Benign solid tumors are only rarely seen in the urethra. The majority of these belong to the group of fibromyomas. One case of fibroma of the female urethra is reported.

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## MALIGNANCY OF THE UNDESCENDED TESTIS—ASSOCIATED WITH HYDROCELE \*

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MALIGNANT disease occurring in the undescended testis is rather uncommon. It was the belief for many years that every undescended testis was peculiarly liable to undergo malignant degeneration. A study of the literature of the past twenty years on retained testes discloses the fact that malignant change in the undescended testis is a comparatively rare surgical lesion.

Eccles in his studies embracing 859 cases of cryptorchism found not a single case of sarcoma. Furthermore, in 40 cases of sarcoma of the testis, he found only one occurring in a retained testes. Coley's statistics of the Hospital of Ruptured and Crippled, including 1357 retained testes, likewise contained not a single case of malignancy. Coley has observed during the past 25 years, 65 cases of malignancy of the testicle, 52 of which developed in the normally descended testes and 12 in the undescended. Kocher found in 1000 retained testes only one in which malignant changes had taken place. He collected from the literature 59 such tumors. Odiorne and Simmons cite 54 cases of malignant disease of the testes observed at the Massachusetts General Hospital during a period of 26 years. Of these 6, or 11 per cent., occurred in the undescended testes. Brenner, of Eiselsberg's Clinic, between the years 1889 and 1918 operated upon 75 inguinal testes. Of these 2 were bilateral, 42 right-sided and 31 left-sided; 24 were operated upon before puberty and 51 after puberty. In the above series one case was associated with hydrocele, and in every subject, with the exception of two, there was an accompanying inguinal hernia. The two cases were associated with interstitial hernias. There was no instance of malignancy in this series of cases.

Bland Sutton, in 1910, could find in the museums of the London hospitals only 14 specimens of malignant undescended testicles. He states: "In a few cases the testis was retained in the abdomen, but in most cases it had entered the inguinal canal." Kaepplin remarks that many of the best-known French surgeons have never observed a single case. Bulkley (1913) says he found no cases reported before 1859 and since then has found only 57 malignant abdominal testes in the medical literature of France, Germany, Russia, Italy and English speaking race. Bulkley in 182,729 male admissions to general hospitals found three cases of malignant intra-abdominal testicles, and in 12,729 consecutive male admissions to the Presbyterian Hospital (New York City) found 13 malignant testicular tumors. Of the latter, 11 were in the scrotum and 2 within the abdomen. Bulkley's analysis of malignant scrotal and abdominal testicular tumors gives the relative frequency of the two conditions as about 1 to 15.

The monograph of Höffstatter, who carefully collected and studied the literature, further confirms the fact that the danger of malignant degeneration in

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retained testes is much less than has been supposed. Höffstatter personally observed 181 cryptorchids, of which 4 had undergone malignant changes, 2 sarcoma, 1 carcinoma and 1 teratoma.

Doctor Nassau informs me that in an active surgical experience in various hospitals covering a period of 25 years, he has observed only one case of malignant degeneration in the undescended testicle. In this same span of time he has removed eight malignant tumors occurring in endoscrotal testes.

Howard found among 110,000 male patients admitted to one of the large London hospitals during a period of 20 years, that there were 65 cases of malignant testicular disease. In 57 of these cases the diagnosis was verified by the microscope; 9 of the 57 were in the retained testes, 8 being in the inguinal canal and 1 just below the external abdominal ring.

Von Kahlden reports 41 malignant testes, of which 5 occurred in the retained testes.

Goeritz, in his study of 57 cases of operated undescended testes, found only one undergoing malignant changes.

Chevassau collected 128 cases of tumors of the testicle; of these 10 were inguinal and 5 abdominal.

Ufferduzzi collected and studied from various clinics, hospitals and pathological museums 159 testicular tumors which had been removed surgically or at post-mortem; of these, 6 occurred in the undescended testes.

In Hinman's study of 32 cases, 7 of the tumors occurred in the undescended testes, which Hinman states supports the view that malignancy is relatively more common in men with undescended testes than in those with normally descended testes.

Cunningham, commenting on the rarity of malignancy of the undescended testes, states that of 67 cases of malignancy of the testes observed at the Boston City Hospital, not one occurred in the undescended testis.

No statistics, however, approach the number of cases of undescended testes reported by Coley (1357), Eccles (859) and Kocher (1000). Collectively they total 3216 cases and in this unusually large number of cases there occurred but one undescended testis undergoing malignant degeneration. If, on the other hand, the various large series of malignant testicular tumors collected in this study, excluding reports of isolated cases, are totalled, they number 664. Of the latter 63, or 9.3 per cent., occurred in the undescended testes.

Von Foth (1910) collected 210 malignant testicular tumors occurring in the undescended testis; including the series of Kocher (55 cases), Monod (42 cases), Goddard (20 cases), Fischer (39 cases), Rademacher (10 abdominal testicular tumors) and a number of smaller series and reports of individual cases. Von Foth's collected cases were not included in this study as they give no index as to the relative frequency between growths occurring in endoscrotal testes and those occurring in undescended testes.

It may be said, therefore, that malignant changes in the undescended testes are relatively more common than in the normally descended testes, but that the danger of its occurrence has been greatly exaggerated and overestimated.

CASE — (History No. 21833, Doctor Nassau's service).—Patient was admitted to Mt. Sinai Hospital, December 31, 1920. The patient was a male, age forty-five, who was brought into the Emergency Ward because of the sudden and rapidly increasing enlargement of a mass over the right inguinal region. Five days before admission to the hospital (December 25, 1920), following an unusual physical effort, he was seized with acute, sudden, sharp, agonizing pain over the right

inguinal region. The mass previous to December 25, 1920, was symptomless and patient states that there was no apparent increase in size. The onset of the pain and the increase in the size of the lump were simultaneous, appearing abruptly and reaching the size of a foetal head within forty-eight hours.

Examination showed a well-developed and well-nourished male somewhat shocked and suffering severe pain over the right inguinal region. The latter area was occupied by a mass the size of a foetal head which had a tense, elastic, cystic feel and fluctuated slightly. The surface blood-vessels were somewhat dilated. Previous history is negative. He is the father of four children, all living and in good health. Occupation, tailor. The past history and family history are negative. Wassermann, negative. Heart normal in outline, sounds good, quality regular. Extremities negative, reflexes normal. Mucous membranes negative. Hair, scalp and nose negative. Pupils of the eyes equal, regular, react to light and accommodation.

The left testicle is in the scrotum and is apparently normal, penis normal, the inguinal lymph-nodes are not enlarged. The right testicle is absent from the scrotum. In the right inguinal region is a large, tense, cystic ovoid mass the size of a foetal head. Epididymis could not be palpated. Mass does not transmit light, probably due to thickening of the sac, and cannot be reduced into the abdomen.

The rapid enlargement of the right inguinal mass and the absence of the testicle from the scrotum of the same side prompted a tentative diagnosis of hæmatocele, or more probably hydrocele, associated with malignancy of the undescended testes, and operation was advised. The malignancy of the testicle had probably been present for some time, and, as is the case with many of the testicular tumors, the growth was symptomless and unnoticed by the patient. The sudden development of the hydrocele and its accompanying pain prompted him to seek immediate surgical aid.

*Operation* (December 31, 1920, by Doctor Lipshutz).—An incision was made extending from the external abdominal ring following the course of the inguinal ligament to a point one-half inch above the anterior superior spine of ilium. The testicle was found lying in an inguinal hydrocele and was removed. The incision was then prolonged to the costal margin to below the tip of the twelfth rib and the radical operation and dissection of the primary lymphatic area was carried out as described by Hinman. There was very little hemorrhage which was easily controlled.

The relative ease with which the retroperitoneal structures can be exposed was strongly impressed upon the right by a number of anatomical studies, which were arrived at in studying the variations in the anatomy of the ureter and hypogastric artery. No glandular metastasis was found. There was a hernia present, the sac of which was ligated and transfixed. A long drainage tube was placed close to the aortic bifurcation with exit at the upper portion of the wound. The suggestion of Hinman in cases with marked gland metastases to place a small rubber tube or catheter, in the end of which is fastened a 50 milligram tube of radium alongside the rubber drainage tube, seems worthy of utilization.

The wound was carefully sutured in muscle layers, care being taken to avoid injury to any of the nerves; to prevent subsequent relaxation of the abdominal wall. The drainage tube was removed in 72 hours. The patient's condition at the end of the operation was good and he made a speedy and uneventful recovery, leaving the hospital on the eighteenth day. He has recently been heard from (ten months after the operation) and is apparently perfectly well. He was also given twenty injections of Coley's fluid and intensive post-operative X-ray radiation.

*Gross Examination.*—The specimen consists of a solid tumor of the testis

measuring  $11 \times 7\frac{1}{2}$  cm. It involves the testes and epididymis and fuses with the surrounding tissues. The tumor is covered with numerous and varying sized nodules exceedingly vascular and is encapsulated by a thin, tense, fibrous capsule presenting on its surface three small hemorrhagic cysts. The testicle cuts with resistance and on section numerous cavities filled with a colloid material are seen scattered over a large part of the tumor. Normal testicular tissue cannot be found. The whole tumor is quite oedematous.

*Microscopic Examination.*—The tumor is very cellular and is composed of large, round, oval and polyhedral cells with but little reticulum or stroma between the cells. In some places an alveolar arrangement can be seen, but most of the tumor does not allow an alveolar arrangement. Many of the cells resemble groups of lymphocytes. The nuclei are large, stain deeply and have a homogeneous ground-glass appearance. No glandular structures or other teratomatous elements are seen. The cytoplasm stains faintly. The tumor presents the characteristics of the group of testicular tumors classified by Schultz and Eisendrath as spermatocystoma or so-called Seminome of Chevasu.

*Comment.*—Ewing in 1911 and Schultz and Eisendrath in 1921 made painstaking critical analyses of the pathology of testicular tumors, adding greatly to our knowledge of these growths, thus aiding to clear up one of the most confusing fields in pathology. Schultz and Eisendrath state that all the tumors can be divided into two groups which will cover all the malignant tumors of the testes of clinical importance, (1) embryonal carcinoma and (2) spermatocystoma. The age incidence of these groups is suggestive. In the first group the average age is 29 years, in the second group the average age is 41; showing the characteristic homogeneous, deeply staining, finely or coarsely granular nucleus. The high average age incidence of the second group is not due to a longer clinical duration of the tumors of this group; on the contrary their rate of growth is more rapid and the duration shorter in the second than in the first.

Schultz and Eisendrath believe that the glandular or adenomatous character of the malignant tumor of the testicle is the best criterion of the teratomatous origin of such tumors. Ewing's designation of this group of tumors as embryonal carcinoma seems the best and is also adopted, as noted above, by Schultz and Eisendrath.

Spermatocystomata, the large-celled medullary tumors so commonly designated in the literature as "sarcoma," are believed by Schultz to arise from the epithelium of the seminiferous tubules. Schultz and Eisendrath suggest the name spermatocystoma for this group of tumors, to indicate their origin from cells of the spermatogenic cycle, as perhaps better than Seminome of Chevasu. The reader is referred to Schultz and Eisendrath's paper for the detailed study of the histogenesis of malignant tumors of the testicle. Ewing believes that the malignant testicular tumors are of teratomatous origin and are the result of one-sided development and overgrowth of a typical epithelial tissue.

*Lymphatics.*—Malignancy of the testicle spreads by the lymphatics rather than by the blood stream. Generalization is in the majority of cases through

the lymphatics. The richness of the lymphatic plexus of the testes readily explains the early glandular metastases. The lymph-vessels are usually more superficial than the blood-vessels with which they are in intimate contact. The testes have a rich superficial plexus beneath the tunica albuginea. They unite with the lymphatics of the epididymis and form from four to eight collecting trunks which ascend with the spermatic veins in the spermatic cord along the front of the psoas major in the subperitoneal tissues to the level where the spermatic vessels cross the ureter. Here they part from the blood-vessels and spray themselves fountain-like into the lateral and pre-aortic lumbar nodes below the renal vessels. Some of the vessels divide in their course and empty their contents into more than one node. The primary lymph-nodes are those in front of and by the sides of the aorta and vena cava below the level of the renal veins.

Each testicle has its own set of lymph-nodes which communicate with each other and both sets receive lymph from other structures. Cancer of the testicle metastasizes in practically every case first and primarily to this limited zone of lumbar lymph-nodes.

*Right Testicle.*—One to three lymph-nodes lie in the groove between the aorta and the vena cava. The more caudal of these nodes is situated above the bifurcation of the postcava. One or more nodes lie in front of the aorta (preaortic nodes) between the renal vein and the origin of the inferior mesenteric artery. A node may also be present to the right of the postcava between it and the right renal vein. Bartels and Cuneo state that one of the lymph-vessels constantly passes to a node situated on the ventral surface of the aorta at its point of bifurcation. In one third of the cases it is present at the level of the promontory of the sacrum; at which site the aorta occasionally bifurcates (Lipshutz).

*Left Testicle.*—The glands lie at the left side of the aorta generally in a cluster behind the inferior mesenteric artery and between the two great trunks (aorta and postcava) below the level of the renal veins. Some of the lymphatics reach the preaortic nodes above the origin of the inferior mesenteric artery. A chain of glands is also present on the outer side of each common iliac artery.

Zeissel and Horovitz describe a lymph-vessel which passes from the testicle to the posterior surface of the bladder to terminate in a lymph-node of the external iliac chain. This lymph-node lies on the external iliac vein where the latter vessel is crossed by the ureter. Most and Bartels were unable to inject this node in man. Bruhns and Jamieson and Dobson, however, successfully demonstrate this node. Cuneo by injection from the testicle also demonstrates this node at the point where the ureter crosses the external iliac vein.

The secondary lymph-nodes or those receiving efferents from the primary nodes are injected with great rapidity. They are composed of three groups,

(1) primary nodes of the same and opposite sides, (2) nodes behind and between the two great trunks (aorta and vena cava) below and above the renal veins, (3) a chain of nodes along the outer side of the common iliac artery.

The glands vary greatly in number and in their arrangement. In two-thirds of the cases the lymph-nodes of the left testicle are placed at a somewhat higher level than those which receive the trunks from the right testicle.

Surgically, we regard the lymph-nodes as lying in an area bounded above by the renal veins, at the sides by lines drawn vertically a finger's breadth outside the vena cava and aorta respectively, and prolonged to cross the external iliac arteries above the junction of the upper and middle thirds, below the lines drawn from the bifurcation of the aorta to meet the extremities of the vertical lines (Jamieson and Dobson).

Most considers the primary lymphatic nodes as a very imperfect barrier. Jamieson and Dobson state that the secondary lymph-nodes are injected with great rapidity. A fact further confirmed by the great frequency of reports of left subclavicular and supraclavicular adenopathy in malignant disease of the scrotal and inguinal testicle. Most further demonstrates the passage of lymph-vessels from tunica vaginalis to the region of the cysterna chyli. It may be noted that the supraclavicular adenopathy may have its origin in visceral metastases from the liver following malignancy of the testicle.

Küttner has demonstrated the passage of lymph-vessels from the liver and stomach to the supraclavicular nodes, particularly on the left side. The appearance of large nodes in the supraclavicular area may also be the result of invasion of the thoracic duct. Metastases in the supraclavicular nodes originating from tumors of the testes and abdomen associated with invasion and occlusion of the thoracic duct, have been explained by several observers as illustrations of retrograde lymphatic growth. It is a late symptom as is evidenced by its occurrence in cases of malignancy of the testes, with metastatic tumor formation in the skin and skeleton. In one case of Monod's series of testicular tumors, there appeared multiple cutaneous metastatic nodules scattered over the cutaneous surfaces. Similar cases have been described by Trelat, Duplay, Guyon, Kõcher, Miyata, O'Crowley and Maitland and others. Of 34 malignant tumors of the testicle, Butlin found the lymph-nodes free in only three.

Invasion of the spermatic and iliac veins with continuous tumor growth extending as far as the heart has been observed with chondrosarcoma and chorioma. Discontinuous metastases by way of veins are most frequent and they give rise to tumors of the lungs, brain, kidney and stomach.

*Hydrocele.*—The occurrence of hydrocele is an uncommon complication of undescended testes. The accompanying hydrocele may be of any type. The types of hydrocele that may be found with retained testes are the following (V. Foth).—1. Complete inguinal or abdominal hydrocele. 2. Hydrocele of the tunica vaginalis in an inguinal testicle. 3. Hydrocele multilocularis

abdominalis with an inguinal testicle. 4. Hydrocele funiculi spermatici with an inguinal testicle. 5. Hydrocele communicating with an inguinal or abdominal testicle. 6. Hydrocele bilocularis with cryptorchism.

The hydrocele may be congenital (hydrocele neonatorum) or may have its genesis in trauma as in the case herein described. Often the hydrocele is present as a fluctuating swelling in the inguinal canal within which lies the testicle, with the additional presence laterally or medially of a hernia, as in the case here reported. One finds at times in young children in which at birth the left testicle is absent from the scrotum and some days later the testicle reaches its normal site, there occurs an accumulation of fluid in the tunica vaginalis testes.

Bescancon reports two cases of inguinal testes connected with scrotal hydroceles. Rothman collected 30 cases of hydrocele accompanying the undescended testes. Rothman, Ufferduzzi, Coley, Hubbard and others report cases of hydrocele bilocularis accompanying an undescended testis. Coley in a considerable number of cases found a bilocular sac in which the upper portion assumes the inguino-superficial variety, resting upon the aponeurosis beneath the skin and superficial fascia and the lower loculus extending down into the scrotum. In these cases the testis usually occupies the upper loculus. The latter types of hydrocele are due to an abnormal diverticulum of the processus vagini peritonei. The processus vaginalis which in the female has no significance is a peritoneal diverticulum through which the ostium abdominalis communicates with the abdominal cavity. This blind sac extends caudally irrespective of the position of the testes to the scrotum. On the arrival of the testis in the scrotum the gubernaculum shrinks away. The abdominal opening of the processus vaginalis is closed through the apposition of its peritoneal surfaces and is the fovea inguinalis lateralis. Normally the closure of the processus vaginalis proceeds rapidly after birth.

Variations in the descent of the testes are often associated with variations of the processus vaginalis peritonei in the nature of diverticuli between the layers of the abdominal wall and under the skin and are also the direct cause of interstitial and præaponeurotic hernia.

It is interesting to note that Osler in 1907 calls attention to the diagnosis of abdominal tumors in the male and states that no such diagnosis is complete unless an examination of the testis has been made. He reports three cases of abdominal tumors due to retained abdominal testes associated with probable hydrocele and glandular metastases. It may be noted that as the intraperitoneal nodes are often involved, an epigastric tumor is frequently the first sign of recurrence. Clendenning and Outland report an enormous abdominal cyst due to a retained testis. There are also case reports of abdominal hydrocele in women. The cases of Abel and Marion were testicular abdominal tumors occurring in hermaphrodites with the normal external genitalia of women and were diagnosed uterine myoma, the true nature of which was not disclosed until the abdomen was opened at operation.

Microscopic examination of the growth showed normal testicular parenchyma and they were both cases of carcinoma of the abdominal testes.

*Trauma.*—Ewing states that trauma seems to be the sole tangible factor in originating many tumors of glia tissue, testicle and many other organs. By trauma is here understood single or repeated more or less contusing, crushing or lacerating mechanical injury. Single severe trauma has frequently been followed by the development of a sarcomatous tumor, although rarely by carcinoma.

Osler and others have commented on the influence of trauma as a factor in causing the rapid generalization of a malignant growth.

Fischer collected six cases of carcinoma of the undescended testes which he believed were due to the wearing of a truss. The inguinal testicle which has been described as a "cherry hanging on a stem" is so situated as to render it more susceptible to trauma than the endoscrotal testis. Furthermore, every contraction and every movement of the abdominal muscles compresses and injures the inguinal testis. The abdominal testicle is relatively free from these effects and is only influenced by a distended bladder, peristalsis, etc. The effect of intra-abdominal pressure can only be conjectured. Bulkley says that only two of his 59 collected malignant abdominal testes gave a direct history of trauma.

Katzenstein, Finotti and others have attributed the occurrence of malignant degeneration to disturbed function and embryologic defects.

The histologic alteration present in the undescended testis does not seem to be an etiological factor of importance in the development of malignancy in the retained testis, when the fact is recalled that malignant degeneration in an undescended testicle which has been placed in the scrotum by operation is of extreme rarity. The writer in a perusal of the literature has been able to find but three cases in which the latter eventuality occurred; one reported by Coley, the second by Cunningham and the third by Gordon Taylor. Apropos of Coley's case which was included in his series of undescended testes, but was operated upon by another surgeon, Coley is inclined to believe that the malignant degeneration was present before the orchidopexy was performed, not being recognized at the time of operation; the malignancy becoming clinically evident one month following operation.

Definite injury frequently precedes the appearance of the various forms of teratoma testis, and, since trauma is an effective method of parthenogenesis, there is good reason to believe that the relation of this injury to the tumor is in this case direct, for these tumors develop from aberrant sex cells. Stockard believes that teratoma in man often occurs as the result of a twin inclusion. Throughout the entire series of embryonal tumors, there is a sound basis for ascribing more than ordinary significance to a history of severe or mild and repeated injury (Ewing).

The importance of the relationship between trauma and malignant disease

from an industrial standpoint has recently been emphasized in an editorial of the *American Medical Association Journal* and referring to tumors of the testicles, the editor states that the round-cell tumor of the testicle which some authors call carcinoma, seems to be the only malignant growth of organs which is definitely produced by a single traumatism. Ophuls believes that such cases are frequent. Grassman collected 20 cases of malignant testes from the Pathologic Institute of Munich. The work of Grassman shows 19 of the tumors occurring in men of the working classes; similarly Miyata found 15 of 27 cases occurring in the working classes. In the case herein reported, the history of trauma bears a definite relation to the appearance and development of the tumor.

Trauma as an active cause in the development of malignancy of the testicle is attested by many case reports and a number of the studies carried out to this end.

*Prognosis.*—The mortality is very high. Very few recoveries from malignancy of the undescended testis can be found in the literature. Chevassau reports of 100 malignant testicular tumors treated by castration, 81 died and 19 recovered. O'Crowley and Maitland reporting 13 cases of malignant disease of the testicle, 7 died, 3 within one year, 2 within two years and 2 within 3 years. Miyata, quoting Gross, Sidney, Mayer and Bierbaum, states that the expectation of a favorable result following the removal of a primary growth is only 31 per cent. The remaining 69 per cent. of the operated cases were already inoperable or metastasis was present which was overlooked. Legueu reports a series of 100 testicular tumors with 19 cured after three years. In Bulkley's collected cases, excision was done in 37 with a mortality of 10 per cent.; only one of the 37 remained well over two years. Coley states that the duration of life in malignancy of undescended testicle is worthy of especial note, it being much shorter than in the ordinary scrotal type. The clinical course is very variable and may be rapidly fatal. In Blank's collected cases of malignant abdominal tumors, the duration of life after the appearance of the growth was between 13 days and 4 years. In Chevassau's collected cases of abdominal malignant testicles, death occurred from 2 months to one and one-half years following the appearance of the growth. Five of the six cases of Odiorne and Simmons died within one year. Of Kocher's 55 collected cases of malignant undescended testes, there was not one case of cure. Howard was able to trace only three of his nine cases of malignant inguinal testes, two of them died rapidly with recurrence in the lumbar glands, while one was alive and well two years and nine months after the operation.

The prognosis is dependent as in malignancy elsewhere upon an early diagnosis and a prompt radical operation.

*Treatment.*—As noted above, malignancy of the testes and particularly of the retained testes offers a most gloomy prognosis unless early and prompt surgical treatment is carried out, as the lymph-nodes are early involved.



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There are several procedures open to the surgeon in operable cases. 1. Orchidectomy followed by a thorough course of treatment with the mixed toxins of *Bacillus prodigiosus* and erysipelas as recommended by Coley. 2. The radical operation of removal of the testicle with its primary lymphatic zone as proposed by Chevassau and strongly advocated by Hinman and others. The operation that is usually performed is castration. Malignancy of the testes treated by simple castration is highly fatal with a final mortality of over 85 per cent.

An analysis of Coley's cases treated by castration and toxins shows a certain mortality of over 80 per cent. In 7 of the 12 cases of undescended testes, death occurred within one year from the beginning of the first symptoms, only 3 cases lived over 3 years, and in all of the latter mixed toxins were used after operation. None of the cases, however, have lived long enough to be pronounced cured.

The high mortality following simple castration urgently indicates the necessity of complete surgical extirpation of the testicle with all the lymph-nodes in direct line for metastatic infection. The presence of clinical evidence indicative of lumbar metastases or an epigastric tumor, renders the case unsuitable for the radical operation. The latter is of no avail once the primary lymphatic zone has been passed and secondary metastases are clinically evident.

The careful analysis of Miyata shows but 31 per cent. of the cases suitable for operation, necessitating a careful selection of the cases in which the radical operation is to be carried out.

It should be remembered that enlarged lymph-nodes do not always signify malignant invasion. Changes in lymph-nodes draining malignant tumors show that the implantation of metastases is preceded by a period of preparation of the soil (Ewing). For weeks or months before actual tumor invasion the regional nodes are moderately swollen. During this period many new lymph-nodes may develop in the course of the vessels (Ewing, Küttner). These changes are the result of the absorption of toxic products from the tumor, either autolytic or bacterial. When the metastatic period is established, lymph-node invasion may follow rapidly. In a few cases the tumor cells skip the regional lymphatics and yield distant metastases.

Edwin Beer, in a monograph on tumors of testicle, supports the radical operation and has put the problem thus. Even though at present the mortality of this operation is higher than that of simple castration, experience has shown that such is the case in all new operations. The writer feels that the mortality from this operation will be markedly reduced. Moreover, we are justified in expecting better end results when the gland-bearing area is removed. Operations for malignancy in other parts of the body support this position. The fight against cancer cannot be half-hearted. The surgeon must strike hard or fail in his duty.

Roberts, of Philadelphia, in 1902 performed the operation of complete removal of a malignant testicle with lumbar metastases, but the patient was old and fat and the operation was performed secondary to a recurrence. Gregorie, in 1905, performed the first complete radical operation.

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Hinman's thorough and careful study of this surgical problem and his report of five successful radical operations for teratoma testes without a single troublesome operative or post-operative complication is very encouraging.

Barringer and Dean, in a series of 36 cases of teratoma testes, found but three classified as "primary operable," that is, at time of admission showed by physical examination neither such local extension nor metastatic involvement as would prevent the complete radical removal of the tumor process. The above cases were irradiated before and after operation with the radium pack. Of the three primary operable cases, one is living without recurrence, nine months after first being seen, one is dead and one is lost track of. Hinman, following radical operation without radium, has one patient living after seven years in whom glandular metastases had occurred. Six other patients are all alive over one year. The longest next to seven is four years. In all of the latter cases malignant metastases were found in the gland area removed, except in two. The case of the writer is living one year after the operation; no glandular metastasis was present in the author's case.

The operation in the case herein reported was carried out essentially as described by Hinman (in *Surgery, Gynecology and Obstetrics*, May, 1919, p. 495).

Barringer and Dean say, "That handling the testicle before its vessels and lymphatics are cut tends, we believe, to squeeze tumor cells into the circulation." They, therefore, cut the vas before proceeding with the extraperitoneal dissection of the lymphatic area, the testicle lying in its bed during this dissection, the latter being dissected out and removed as the final stage of the operation and the wound sewed up.

Radium is a very valuable adjunct in the treatment of these cases and seems of particular value in cases where large inoperable masses are present. Barringer and Dean in from three to six weeks after the wound is healed again apply radium packs over the length of the scar.

In the successful removal of glandular metastases, resection of the inferior mesenteric artery may be required. Hinman has tied off many of these arteries in dogs, cats and rabbits with absolutely no effect. Pathologists tell us that it is frequently found completely obstructed without apparent injury to the intestines and other surgeons have tied this vessel next to the aorta without hesitation. Careful studies of the blood supply of the colon, which are now in preparation by the writer, indicate a free anastomosis in this region, frequently the region supplied by the inferior mesenteric artery has additional blood supply from the adjacent vessels. The latter subject will be presented in detail in a later study.

The case reported in this paper was operated upon by the writer in the service of Dr. Chas. F. Nassau at the Mt. Sinai Hospital, and I am indebted to Doctor Nassau for his courtesy in allowing me to publish the case.

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# RESULTS OF TREATMENT IN FORTY-EIGHT CASES OF SCIATICA

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IN a previous paper I reported the results in thirty-four cases of sciatica treated by removal of foci of infection and epidural injections of saline solution. Since then fourteen other cases have been treated in a similar manner. The results from both series are reported herein.

The cases in which this method of treatment was used represent those in which the sciatic pain was not due to diabetes, syphilis, caudal tumor, or other common causes of so-called sciatica. Slight changes in the bone were found in certain cases, but in none could the changes be definitely shown to be the cause of the sciatica.

The symptoms of sciatica are too well known to need repetition. The cases have not been classified into sciatic neuritis and sciatic neuralgia, for such classification is not always possible. Cases in which the sciatic pain could be definitely attributed to some condition of the bone, or to sacro-iliac or hip-joint disease, and those in which the diagnosis was doubtful, have been eliminated.

TABLE I

## SEX, AGE AND DURATION OF SYMPTOMS

Sex	Average age, years	Duration of symptoms
Males, 40	Thirty-nine and one-half	Longest, ten years
Females, 8	Oldest, seventy; youngest, twenty-two	Shortest, three weeks
		Average, eleven and one-half months

## SYMPTOMS

	Patients	Per cent.
Definite attacks with free intervals.....	20	
Pain more or less constant since onset.....	28	58.3
Pain over the area of sciatic distribution on one side.....	48	100
Pain over the sacro-iliac region on one side.....	46	96
Pain over the lumbar region on the side affected.....	37	77
Pain over the lumbar region on both sides.....	14	29
Pain over the areas of sciatic distribution on both sides.....	2	4

## SEVERITY OF DISEASE

Six patients were bedridden, thirty-two walked by the aid of a crutch or cane, ten patients were able to walk without support.

# TREATMENT OF SCIATICA

## CAUSATIVE FACTORS

	Patients
Occupation a probable factor.....	3
History of acute infection preceding attack.....	6
Strain or wrench of the back a possible factor.....	11
No predisposing causes.....	28

## POSITIVE FINDINGS

	Patients	Per cent.
Lasègue's sign positive .....	46	96.0
Atrophy, muscles of extremities affected.....	18	37.0
Achilles reflex diminished or absent .....	24	50.0
Changes in surface temperature of the leg.....	4	8.3
Tenderness over the trunk of the sciatic nerve.....	44	92.0
Limitation of motion of the spine (mild).....	15	31.2
Hypertrophic arthritis of lumbar spine (mild).....	6	12.5
Sacro-iliac disease (?).....	2	4.1
Hypertrophic arthritis of hip (mild) .....	1	2.0
Hypertrophic arthritis of knee (mild).....	1	2.0
Lesion of the fourth and fifth lumbar vertebræ (character unknown) .....	1	2.0
Old healed fracture of the femur.....	1	2.0
Fusion of sacrum and fifth lumbar vertebra.....	1	2.0

The prominent symptoms and findings are tabulated in the accompanying table. It will be noted that all of the patients complained of pain over the lower area of sciatic distribution, in the sacro-iliac region in ninety-six per cent., in the lumbar region on the side affected in seventy-seven per cent., and on the opposite side in twenty-nine per cent. Bilateral sciatica was present in two cases (four per cent.). Of the objective symptoms, tenderness over the sciatic trunk was present in ninety-two per cent. of the cases, Lasègue's sign was positive in ninety-six per cent., there was atrophy of some of the muscles of the extremity in thirty-seven per cent., and the Achilles reflex was diminished or absent in fifty per cent. On the whole, however, neurologic findings were mainly negative and the diagnosis had to be made largely from the subjective symptoms.

After all cases have been ruled out in which sciatica is caused by some demonstrable condition, such as malignant growth pressing on the lumbosacral plexus, sacro-iliac disease, syphilis, diabetes mellitus, tumor of the pelvis, and so forth, there still remains a large group of cases of sciatica, perhaps, the larger group, in which the cause of the sciatic pain must be looked on as the result of an infectious process. The exact seat of the pathologic process is not always determinable. Dejerine and his followers classify sciatica into two groups: neuritis of the trunk and neuritis of the roots. Others<sup>6</sup> attribute rheumatic sciatica to osteo-arthritis of the intervertebral foramina with secondary neuritis of the roots.

Observations were made after the injection of 60 c.c. of a solution of methylene blue into the epidural space of a fresh cadaver. The fluid passed

to the outer edge of the ganglia about 0.5 cm. distal to the site of branching off of the dorsal nerves; in the sacral region, however, it passed slightly farther. The fluid did not reach the subdural or subarachnoid space. The pressure of the injected fluid is exerted either on the roots covered by a fold of dura or on the ganglia in the foramina and slightly beyond (Fig. 1). The fact that ninety-six per cent. of the patients experienced pain over the areas of sciatic distribution on the diseased side and not on the opposite side during the injection, is evidence that either the roots or the ganglia were hypersensitive on the affected side. If the inflammation were distal to the ganglia exclusively, pain from the pressure of the fluid should not be experienced on the affected side more than on the unaffected side, if at all. Incidentally, it was noted that the fluid passed epidurally to the upper cervical region; in fact, there was as much fluid in the cervical region as was present in the lumbar region. These results are somewhat different from those reported by Thompson.

Interstitial fibrosis and thickening of the sheath of the sciatic trunk are described in the literature, but I have been unable to find reports of careful histologic studies of the roots and ganglia in cases of sciatica. As yet information is very incomplete concerning the pathologic changes and the location of lesions in so-called idiopathic sciatica. In view of the fact that in the greater percentage of the cases under consideration, symptoms were caused probably by an infectious process directly affecting the roots, the ganglia, or the trunk of the sciatic nerve, or possibly were due to toxic products from infection elsewhere in the body, causing deleterious changes in some of these structures, it seemed important to remove all possible foci of infection. Of the forty-eight patients whose cases are presented, twenty-two had infected tonsils and fifteen had foci of infection around the teeth.

Various methods for the treatment of sciatica have been tried, all of which are more or less unsatisfactory. In the earlier methods of treatment, various chemicals were injected along the course of the nerve; Schleich, in 1895, used massive infiltration of his anæsthetizing solution along the course of the sciatic trunk. Later, the same method was modified by Bloch. In 1904, Lange used normal saline solution containing eucain, the injection being made into the nerve by inserting the needle into the ischiadic foramen by a technic which he described, using from 100 to 150 c.c. of the solution. Various men have used, and are still using, this method or a modification of it; some report good results, some poor. Treatment by nerve stretching has fallen into disuse. In 1901, Cathelin and Sicard each described the method of epidural injection into the sacral canal, using cocain solution. In sciatic neuralgia these men used cocain in saline solution. Since that time this method has been quite extensively used and some very favorable results have been reported (Strauss and Feuillade). Among others, Rosenheck and Finkelstein, found the results disappointing. Feuillade states that he was able, by repeated injections, to keep many soldiers on duty who would otherwise have been hospitalized.

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FIG. 1.—Epidural injection.



FIG. 2.—Insertion of needle for epidural injection.





## TREATMENT OF SCIATICA

The technic of the injection is rather simple and has been described quite fully by Cathelin, Strauss, and others. The armamentarium consists of a 20 c.c. Leur syringe with an ordinary spinal puncture needle. The needle is introduced through the hiatus sacralis into the sacral canal for a distance of from five to six cm. (Fig. 2). Care should be used not to introduce the needle far enough to puncture the dura, the reflection of which takes place in most cases at about the upper margin of the second sacral vertebra. After the introduction of the needle, the trocar should be removed and suction with the syringe made so that the operator may be sure that he has not punctured the subdural space. In case this happens the needle should be withdrawn for from two to three cm. The solution which we use is, ordinarily, five-tenths per cent. novocain in physiologic saline. The fluid is introduced slowly to prevent severe pain; fifty c.c. is sufficient usually for one injection. If relief is not obtained the injections may be repeated every forty-eight hours; sometimes seven or eight injections are required. It has been our experience that in most cases the first injection relieves the pain entirely for two to three hours and ameliorates it for from two to ten days, but that usually one or two more injections are necessary for total relief.

Of the forty-eight patients treated by epidural injections, nineteen had one injection, fourteen had two injections, nine had three, six had four. Fourteen patients were relieved completely and permanently, eighteen were relieved partially, so that they were able to return to work, one was relieved for one month, and fifteen received no permanent benefit. Forty-one of the forty-eight patients obtained temporary relief, that is, relief lasting from two days to two weeks.

These results do not take into consideration that in the larger number of cases, foci of infection were removed either a few days before or a few days after the injection, and that in some instances their removal was probably a factor in the cure (Table II). However, eight patients were permanently cured by injections alone.

TABLE II  
RELATION OF ERADICATION OF FOCI TO RESULTS

	Patients
Foci of infection were removed in.....	30
Patients permanently relieved.....	14
Foci of infection removed in.....	6
Foci not removed in.....	8
Patients partially relieved permanently.....	18
Foci removed in.....	14
Foci not removed in.....	4
Patients not relieved permanently.....	15
Foci removed in.....	9
Foci not removed in.....	6
Patients relieved with recurrence.....	1
Foci removed in .....	1

These results are not so striking as those reported by other writers. Feuillade reports eighty per cent. of cures of primary sciatica resulting from exposure, by epidural injections in cases among soldiers. Bum reports that in so-called radicular sciatica seventy-two per cent. of the patients were cured and seven per cent. improved by epidural injections; that in chronic sciatica of the trunk eighty-three per cent. were cured, and ten per cent. improved, by treatment by Lange's infiltration method.

While our results are not entirely satisfactory, yet we feel that the procedure is indicated and justified in certain selected cases. As yet we do not know the relative merits of the injections and the removal of foci of infection in producing beneficial results.

#### SUMMARY

In forty-eight cases of sciatica in which no definite causative factor could be found, repeated epidural injections, combined with the removal of possible foci of infection in a large percentage, resulted in permanent cure in twenty-nine per cent., and permanent amelioration of symptoms so that the patient was able to continue his occupation with a fair degree of comfort in thirty-seven per cent.; in the remaining thirty-four per cent. no permanent beneficial results were obtained.

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TRANSACTIONS  
OF THE  
PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held March 6, 1922*

The President, DR. JOHN H. JOPSON, in the Chair

MALIGNANCY OF THE UNDESCENDED TESTIS

DR. BENJAMIN LIPSHUTZ read a paper with the above title, for which see page 260.

GASTROSTOMY

DR. THOMAS A. SHALLOW read a paper with the above title.

ACTINOMYCOSIS

DR. PENN G. SKILLERN, JR., presented a man, twenty-eight years of age, who was first seen November 30, 1921, with an inflammatory induration of the floor of the mouth, both sides, bounded by the horseshoe curve of the mandible and pointing in the midline midway between the chin and the hyoid bone. At this spot the abscess was incised, liberating a quantity of foul, creamy pus with the stink of a colon bacillus infection.

At first sight this infection suggested Ludwig's angina, but the tongue was not pushed up or fixed. Skiagrams of the teeth for root abscesses and for salivary calculus were negative. A month later—December 30th—the abscess had cleared up and the wound was healed; there remained, however, a slight induration of the tissues around the incision such as frequently follows incision of an abscess of this type. The patient was discharged, cured of the abscess.

About two months later—on February 20, 1922—the patient reported again with an induration the size of a walnut in the submental region, pointing at the site of the former incision, midway between the chin and hyoid bone. Again the mass was incised, but only a few drops of thin, whitish pus escaped, and the greater part of the indurated area remained. Inspection of two of the three drops of pus showed in each a few granules the size and shape of the head of a pin and grayish-yellow in color. The patient was now questioned relative to having worked around a barn or stable. He stated that in July, 1921, he decided to fix up an old stable for a studio. He therefore spent the first two weeks of that month cleaning manure from the ground floor of a stable that had been used for fifteen years, and washing down its walls. The manure was caked to a depth of from six inches to a foot, and it took him two days to remove it. Toward the end of the next month—August—he broke off the crown of a front tooth and went to the dentist, September 1st. About two months after cleaning the

stable he noticed that when lifting his chin up to shave he experienced a "drawing" sensation in the submental region. This condition remained stationary for two weeks when the patient "caught cold," whereupon the submental region began to swell until it became very hard, but it did not pain until a week later.

Having obtained in the reconstruction of the history data so suggestive of infection with *Actinomyces bovis*, the reporter sent the few drops of pus to a laboratory. Examination of a granule crushed between slides revealed the presence of a ray-fungus.

The patient was immediately started upon ascending doses of a saturated solution of sodium iodide, and now, after two weeks of this treatment, the swelling has diminished to the size of a pea, and the incision is closed.

With regard to the treatment of actinomycosis, Doctor Skillern said that the potassium iodide does not act on the organism itself, but seems to enable the tissues to overcome the disease. It is useless in small doses. Ochsner recommends the treatment of Bollinger, who taught that if we treat cases of actinomycosis exactly as the disease is treated in cattle, the patients will recover just as regularly. Ninety grains of iodide are given in one-half pint of milk, followed by one pint of hot water, every eight hours, for four days; omit for one week, then repeat until there is no sign of the disease for at least a month. Repeat the course once or twice a month after the patient has apparently completely recovered. Fördel, in 1908, showed at the German Surgical Congress six cases of actinomycosis cured by cacodylate of sodium internally, which he believes preferable to the iodides. Kolmer, in Keen's Surgery, states that if the iodides fail, the surgeon may try an autogenous vaccine, and cites Malcolm's case of two years' duration, in which, iodide being swallowed month after month and pound after pound, two sinuses and a nodule gradually healed under weekly subcutaneous injection of a vaccine containing 4,000,000 to 5,000,000 actinofragments. Collie reports a case of actinomycosis successfully treated by a vaccine, which was prepared by Sir Almroth Wright. In this case, too, the iodide had been given freely, but wholly without effect. He was first given a stock, later an autogenous vaccine, and about seventeen inoculations were required to effect cure.

DR. ROBERT H. IVY said that these cases are rather rare, particularly in this country, and that he was surprised that Doctor Skillern's case had healed so quickly under the potassium iodide treatment; thinks this was because of its superficial nature. The most recent literature on the subject tends to the belief that potassium iodide has been overrated in the past, and inclined to a greater dependence on free drainage, X-rays and radium, and possibly vaccine therapy. A recent paper by Colebrook in the *London Lancet* divides the organisms into four types which have cultural differences, but which give rise to the same clinical picture. Doctor Ivy said that last year he had a case of actinomycosis involving the parotid region which was more resistant to any form of treatment than the case reported by Doctor Skillern.

## LUXATION OF FOOT

### COMPOUND LUXATION OF ELBOW WITH RUPTURE OF BRACHIAL VESSELS

DR. EDWARD B. HODGE presented a woman aged fifty-five years, who was admitted to the Presbyterian Hospital, January 11, 1921. While standing on a chair, her heel had gone through, and she fell on left arm, tearing it across the bend of the elbow.

On admission to hospital there was found a three-inch tear which ran from the middle of the bend of elbow inward and slightly downward, with condyles of humerus protruding, brachial vessels torn, but not bleeding, brachialis and part of biceps torn and median nerve intact across wound. Debridement of wound with ligation of vessels. Section of muscle removed, sterile on culture. Wound swabbed with Dichloramine-T, capsule and muscles sutured with chromic gut, skin with silkworm gut, and rubber tissue drain down to muscles. Dressed in Jones' position.

There was good recovery with reaction to  $101^{\circ}$ , slight drainage and no local reaction. Drain removed in forty-eight hours. Slight motion of elbow begun on sixth day. Hand remained warm and of good color, but radial not palpable until thirteenth day. Temperature  $100^{\circ}+$  on third day and was never quite normal until just before discharge.

On eleventh day, cramp and pain in right calf with general swelling and tenderness, but no enlargement of saphenous or tenderness in its course. L. 20,000 on twentieth day, leg less swollen and no pain. Elbow healed and quiet and motion from acute flexion to  $90^{\circ}$ . Temperature,  $100^{\circ}$ – $102^{\circ}$ , now falling.

On the twenty-sixth day severe cramp-like pain in left calf, swelling and moderate tenderness with some fluid in knee-joint, temperature up  $1^{\circ}$ , pulse soft and rapid. Hæmoglobin, 40 per cent.; red blood-cells, 3,250,000; leucocytes, 46,800. No chest signs. Patient gravely ill for a few days. The oedema extended up on to buttock and loin. Then slow, but steady, improvement up until discharge. Out of bed end of eighth week and walking a while later. Elastic support controlled swelling in legs well.

Three months after accident she is in greatly improved general condition, though still anæmic. Arm shows motion from acute flexion to  $160^{\circ}$ .

The rarity of the original condition alone would warrant report. In spite of the sterile culture from the muscle and clean wound healing, there was probably present slight infection in the wound. In the presence of old cardiac lesion and anæmia, this was the probable cause of the phlebitis.

### BACKWARD LUXATION OF FOOT ON LEG WITH FRACTURE OF FIBULA

DOCTOR HODGE presented a woman, forty years of age, who twisted her left ankle. In trying to recover her balance, something happened to her right ankle and she fell to the sidewalk with the right foot in the street. Probably the heel of the shoe caught on the edge of the

curb putting the foot in strong plantar flexion and her weight in this position caused the injury.

When seen fifteen minutes afterward, backward luxation of the foot on the leg was evident. The outline of the articular surface of the tibia could be seen as well as felt, extending nearly an inch over the posterior projection of the heel.

Under gas, reduction was effected less than an hour after the injury. After flexing the leg on thigh to relax the calf muscles, plantar and dorsal flexion of the foot with extension brought easy reduction.

X-ray showed a fracture of the fibula three inches above the lower end, but no other gross lesion. The patient was treated in her home by the use of a fracture box for a few days until the swelling had subsided. Then a split cast was applied. This was removed daily for massage and active motion. Weight-bearing was not allowed for six full weeks as patient was uncertain on crutches and left ankle had been weak for years. Baking and massage were used after fifth week. By these means, swelling and stiffness were greatly reduced and full motion early obtained without pain. After eight weeks, the patient passed from observation, walking well without support and having full painless ankle motion.

Dislocation at the ankle is quite unusual—extremely so without accompanying fracture. This is the only case in the writer's experience. Reduction may be as difficult as it was easy in this case—incision is not infrequently required and difficulty in reduction increases rapidly with lapse of time.

Points emphasized here are rarity of injury and excellent function resulting from early reduction and early active motion.

#### BILATERAL CONGENITAL ABSENCE OF PATELLA

DR. JOSEPH M. SPELLISY exhibited a photograph of bilateral congenital absence of patellæ in a patient about seventy-five or eighty years of age who was in the service of Dr. Wm. Barton Hopkins some fifteen years ago. This man also had a varus deformity of both feet and could not walk well, but he could flex and extend his knees to normal extent despite the absence of knee caps. Doctor Spellisy also presented röntgenograms of another instance of congenital absence of both patellæ which he had observed in a little boy in his service at St. Joseph's Hospital. He regretted that the child's residence, at a distance from Philadelphia, made it impossible to present him. The films exhibited showed not only the absence of patellæ, but other congenital abnormalities, distortions of fingers and toes and of both elbows. The latter enjoyed but imperfect extension.

DR. A. P. C. ASHHURST said he had seen many years ago, one case of congenital absence of the patella on Dr. G. G. Davis' service at the Orthopædic Hospital, which was associated with hyperextension of the knee; he had also seen a number of other cases in which it was thought for a long time there was no patella but in which it was found that a patella subsequently developed.

## NON-ROTATION OF COLON

### NON-ROTATION OF COLON

DR. E. J. KLOPP presented a man, aged twenty-nine years, who, having had no serious illness, was attacked September 28, 1921, at 6 P.M. by colicky pain in the region of the umbilicus, which continued more or less constant, until at the end of two hours it disappeared. He was seen by Doctor DaCosta, who made a diagnosis of appendicitis. He was admitted to the Jefferson Hospital, where the reporter operated upon him. No rigidity, pain radiated downwards and upwards, from umbilicus. Temperature, 98°; pulse, 80; respiration, 24; leucocytes, 15,500. Gridiron incision. Upon careful examination, they failed to find the appendix or the cæcum. Incision was enlarged sufficiently to introduce the hand, and palpate the large intestine, which was to the left of the median line and adherent. They were unable to pull it toward the right side. The small bowel which was found in the right side of the abdomen was rather large. In passing the hand toward the upper right quadrant of the abdomen some abnormality was felt. Because of the fact that some of the pain radiated toward the liver an upper right rectus incision was made, hoping to find the cæcum, but did not find it in this location. They saw the duodenum which was not covered by the colon or the transverse mesocolon. The patient took anæsthesia badly, so that no further exploring was done. The gall-bladder and stomach were negative. Both wounds were closed. Nothing removed. Day following operation temperature was 102<sup>3</sup>/<sub>5</sub>; pulse, 120; respiration, 30. Temperature became normal on sixth day. He was discharged from the hospital, October 20, 1921.

Cases of non-descent of the cæcum are not infrequent. The appendix may be adherent to the gall-bladder, stomach or duodenum. Occasionally the appendix is to the left and above the umbilicus. Delatour reported such a case in the *ANNALS OF SURGERY*, January, 1915. The tip of the appendix was adherent to the left kidney. He reported one case of incomplete descent, and one case of non-rotation with the appendix in the left iliac fossa. In the same number of the *ANNALS OF SURGERY*, Downes reported a case of gastric ulcer with non-rotation of the colon. He performed an anterior gastro-enterostomy with an eight-inch loop with good results.

C. H. Mayo, *Med. Rec.*, March 2, 1912, reported in detail five cases of left-sided appendicitis operated upon in St. Mary's Hospital, three for appendicitis, two for acute abscess. One case diagnosed before operation—from physical signs and X-ray. He states that up to that time approximately 300 cases of complete transposition of the abdominal viscera had been reported in literature. He says that non-rotation of the colon should be considered probable when no colon is found on the right side, and positive if the duodenum is movable—it has a mesentery when it merges directly into the jejunum, and when it is uncovered by transverse colon or its mesentery.

*Röntgenologic Report.*—Patient was referred to the X-ray service of Jefferson Hospital, with the request to locate the appendix if possible. He was given the usual test meal, and in six hours the barium completely emptied through the ileum and small intestine, unable to locate the cæcum. The patient returned after a few days with the intestinal tract empty of the barium. He was given another barium meal which showed the stomach practically normal, tendency to be over rather to the left and high, with the pylorus patulous, and the duodenum patulous with no tendency to abnormality. Barium meals passed down from the stomach into the small intestine, entering the colon somewhere in the pelvis in the mid-line. A colon injection showed that the barium meal took the course shown on the plate. The previous operation made it difficult for them to palpate, but they determined that the colon was on the left side and the small intestine on the right side. There was complete non-rotation of the colon.

In reviewing the literature it appears that the majority of cases are not a complete but a partial non-rotation of the colon with incomplete descent. Often there is a high cæcum with a retrocæcal appendix.

DOCTOR ASHHURST said that several years ago he saw an operation done for chronic appendicitis in which the appendix could not be found. Subsequently, Doctor Ashhurst operated on the same patient for intestinal obstruction and found non-rotation of the ascending colon. The patient died. In the last volume (volume v) of the Medical and Surgical Reports of the Episcopal Hospital, Doctor Voglein reported a patient of Doctor Deaver's with the same condition who was completely relieved of his obstructive symptoms by a cæco-sigmoidostomy.



# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting Held April 12, 1922*

The President, DR. JOHN A. HARTWELL, in the Chair

### INTRAHEPATIC CHOLELITHIASIS

DR. RICHARD LEWISOHN presented a man, thirty-nine years old, upon whom he had operated seven years ago at Beth Israel Hospital. The patient was suffering from severe pains in the right epigastrium, with fever, chills and marked rigidity (peritoneal irritation). Pre-operative diagnosis: acute cholecystitis or perforated duodenal ulcer. Immediate operation revealed that the patient was suffering from intrahepatic cholelithiasis. The whole surface of the liver was studded with innumerable small tumors which simulated malignancy. Incision of one of these small nodules revealed a few small gall-stones. Upon further exploration it was seen that one of these pseudo-tumors, situated at the under surface of the liver, had ruptured spontaneously, thus giving rise to the acute symptoms.

The gall-bladder contained half a dozen stones, entirely different in size and color from those found in the liver. The gall-bladder was drained and the operative field packed with gauze.

The patient made a good operative recovery. A biliary fistula closed spontaneously after eight months. He was readmitted two years later to the same hospital with recurrence of symptoms and operated by Doctor Goodman. No stones were found in the gall-bladder. A cholecystostomy was performed. Patient had a profuse post-operative hemorrhage (cause unknown) which required a revision of the operative field and several transfusions of blood. He has had several light attacks of gall-stone colic during the last few years.

Doctor Lewisoohn stated that this patient represented a unique case, *i.e.*, spontaneous perforation of intrahepatic gall-stones. This case was published in the *ANNALS OF SURGERY*, 1916, vol. lxiii, p. 535. It was certainly remarkable that this patient was in good health to-day without jaundice, though the hepatic ducts with all their branches were filled with stones.

### SARCOMA OF RIB

DOCTOR LEWISOHN presented a patient, eighteen years old, who was admitted to Beth Israel Hospital six weeks ago. The patient had noticed a swelling on the left side of the chest for the past five months. The swelling had grown gradually to its present size (2½ by 3½ inches). The tumor was situated in the axillary line and seemed to originate from the tenth rib. Wassermann and X-ray of the chest were negative.

Aspiration of the tumor did not yield pus. Pre-operative diagnosis: osteochondroma or sarcoma of rib.

The tumor was explored by an incision along the tenth rib and freed from the surrounding tissues. Both pleura and parietal peritoneum presented themselves. The tumor was carefully freed from these structures. That portion of the tenth rib, which was occupied by the tumor, was then resected and the wound was closed.

Pathological report: Round-cell sarcoma.

The patient receives radium treatment in order to prevent a recurrence. These tumors are supposed to be very malignant.

#### URINARY FISTULA FOLLOWING URETEROTOMY

DOCTOR LEWISOHN presented a woman, thirty-two years old, upon whom he had operated at Beth Israel Hospital five months ago. She had typical attacks of vesical colic for about a year previous to her admission. The attacks were very severe and occurred every few weeks. X-ray examination showed a small calculus at the vesico-ureteral junction.

Cystoscopy showed a normal right ureteral orifice. The left ureteral orifice presented a large red slit and protruded into the lumen of the bladder. The left ureter was obstructed right above the orifice, the right ureter patulous.

The left ureter was exposed about  $2\frac{1}{2}$  inches above its entrance into the bladder. Attempts to milk the stone up failed. The ureter was then incised. The stone could not be dislodged with forceps or any other instrument. It was then decided to expose the stone *in situ*. An incision was made at the uretero-vesical junction. The small stone was so densely impacted in the ureteral mucosa that it could only be removed with the aid of a sharp spoon. Both incisions were closed with catgut sutures.

The incision at the uretero-vesical junction healed primarily. The first incision did not heal, leaving a complete urinary fistula on the left side. Cystoscopy and ureteral catheterization showed what appeared to be a complete obstruction on the left side, about  $2\frac{1}{2}$  inches above the orifice. Even very fine bougies could not pass the obstruction. Both kidneys were functioning well (indigocarmine injection).

The patient was very much annoyed by the profuse flow of urine through the fistula, which required constant changing of dressings. A nephrectomy was advised, as a spontaneous cure appeared out of the question after so long an interval, and in view of the cystoscopic findings. However, to the surprise of all who followed the case, the fistula closed spontaneously two and a half months after the operation.

No untoward symptoms followed this spontaneous closure. The patient has been perfectly well during the last year. A recent cystoscopy shows a well-functionating kidney and a slight stricture at the side of the previous urinary fistula.

#### FRACTURE DISLOCATION OF CERVICAL SPINE

DR. ALFRED S. TAYLOR presented a young man, twenty-nine years of age. Six years ago he had dislocations of his patella and his left shoulder. In spite of treatment at the time, he has always been subject to recurrent dislocations of both the patella and the left shoulder.

February 23, 1920, while wrestling, his neck was strongly flexed in a double Nelson hold. Suddenly there was a snap in his neck and he fell to the floor powerless. When he was lifted into bed and placed upon his back, he could move both upper extremities, but with very slight power. The lower extremities showed, as far as he could see, no involvement. There was no disturbance of the sphincters. When he turned the head to either side, or attempted to raise it from the pillow, he had severe pain in the neck. He noticed no disturbance in breathing, except that he could not blow his nose satisfactorily. Movement of the body caused pain in the neck. He also had pain in the right shoulder region.

During the forty-eight hours after the accident, power in the upper extremities gradually diminished until only the fingers could be moved. At that time improvement began, and was steady. He was first seen on February 28, five days after his accident. He was lying on his back in the characteristic attitude associated with an injury at the level of the fifth and sixth vertebræ. The arms were abducted to 90°. The elbows were fully flexed, the forearm partly supinated and the hands lying upon the upper chest. The left arm and forearm could be moved freely with fair power, but the digits had very little power. There was some diminution of sensation on the back of the forearm and hand. On the right side the digits had free motion and considerable power, but the triceps and shoulder cap muscles were distinctly weak. There was also diminished sensation over the postero-external aspect of the forearm and hand. The reflexes were entirely absent in both upper extremities. The abdominal and cremasteric reflexes were absent on both sides. The K-J's were lively on both sides. The A-J's were normal. Babinski was absent on both sides. On the left side there was a very rapidly exhaustible ankle clonus. Ankle clonus was absent on the right side. There seemed to be no loss of power and no ataxia in the lower extremities. Below the level of dorsal ii there was some disturbance in thermal sensation, both hot and cold being called "hot." Either flexion or rotation of the neck to either side caused pain. There was marked tenderness over the lower cervical spinous processes, one of which was unduly prominent. Diagnosis of fracture dislocation of the cervical spine was made. Stereoscopic pictures showed bilateral dislocation forward of cervical v upon cervical vi.

He was taken to the Hospital for the Ruptured and Crippled, on Doctor Gibney's service, where on March 3, nine days after his injury, he was put upon a Hawley table. Suspension apparatus was put about his head and his neck was stretched. After the stretching had continued for a few minutes, steady, gentle hyperextension was used. At the end of five minutes there was a sudden click which the patient felt, and he said his pain was gone. Palpation of the spinous processes showed them to be again in proper alignment. The head could be rotated to either side very much further than before and with absolutely no pain. He also stated that he could move his arms much more freely, and proceeded to demonstrate the fact. This stretching was carried out with the patient on his back and without an anæsthetic. A plaster-of-Paris jacket and

collar were applied right on the table so as to maintain elongation of the neck and definite hyperextension. He was returned to bed in good condition.

A radiograph taken March 6, three days after the manipulation, showed the alignment of the vertebræ to be almost perfect, but the intervertebral space between cervical v and vi was narrower than the others. While his arm movements were more free immediately after the reduction, twenty-four hours later they were back just where they had been before and he had considerable dull, steady pain in the right shoulder region. The pain in his neck was gone and he could rotate his head freely to both sides. After about ten days the plaster jacket and collar had become rather uncomfortable and a reinforced leather collar, with shoulder extensions, was made to replace it. With this harness on he returned home.

On March 23, twenty days after the reduction, further pictures showed considerable recurrence of the deformity. Investigation showed that he had taken off his reinforced leather apparatus for the purpose of shaving, bathing, etc., against instructions. He was taken back to the hospital and an attempt at reduction, similar to the first, was repeated. The reduction seemed nearly as complete as the primary one. Again the plaster jacket was placed on the trunk and neck. A picture taken the day after this second procedure showed almost a complete reduction. He was allowed to remain in the plaster jacket, but at the end of a week it had become so uncomfortable that a new one was put on. It was then thought that a juremast brace, which would take the weight of the head off the neck and maintain hyperextension, would be much more comfortable, and just as efficient as the plaster jacket. Such a brace was made and applied. On June 19 pictures were taken and a recurrence of the deformity was found.

On June 24 he was operated upon under local anæsthesia at the Hospital for the Ruptured and Crippled. A median incision was made from cervical iii to vii inclusive. The spinous processes of cervical v and vi were exposed, also the articular processes between the v and vi. The tissues surrounding the spinous processes and the articular processes maintained the appearance as though they had been damaged only a day or two before, except for the fact that the neighborhood was drier than would be the case in a fresh accident. There was almost no evidence of any reparative process having occurred. The articular processes were not locked; they could be made out clearly and the articular surfaces were just overlapping in the normal relation. Attempts were made, both by manipulating the head, by prying at the bones and finally by using a steel hook under the arch of cervical v to reduce the deformity. The most that could be accomplished was a reduction of about twenty-five per cent. of the deformity. In order to maintain this reduction it was necessary to anchor the spinous processes of cervical v and vi together, and these were so anchored by means of heavy, braided silk sutures, which were passed around them and tied. The spinous processes were still separated by an interval of nearly three cm. The wound was closed,

sterile dressing applied, and he was returned to bed. After healing had occurred he was again allowed to be up and about in his brace. During the interval between the first reduction and the final attempt by open operation, there had been a complete disappearance of all of his motor and sensory disturbances, except that he could not bring his right hand up his back more than sixty per cent. of the normal range. He was kept in the brace until March 17, 1921. In other words, for an interval of practically a year. Toward the end of this time pictures taken to check up on conditions showed the beginning of bony union between the fifth and sixth vertebral bodies, in front—also between—the articular processes behind. This was the condition hoped for, as it would give a reasonably solid support against dangerous recurrence of the dislocation.

The interesting features of this case lie in the lack of reparative capacity in the individual. This is apparent not only in the condition of the soft tissues, as seen at the open operation, but is also in evidence because of the recurring dislocations of shoulder and patella. The injury itself must have been chiefly one of direct trauma to the sixth cervical nerves on both sides, with a moderate amount of damage to the cord itself, as indicated by the modification of the reflexes in the lower extremities and the slight sensory disturbances which were noted.

There could have been no serious damage to the cord, or otherwise disturbances of the sphincters and lower extremities would surely have occurred.

The motor losses, as well as the sensory disturbances in the two upper extremities, must have resulted from direct injury to the nerve roots as they left the spine.

If the primary plaster cast had been left on for several months it is more than likely that the recurrent dislocations would not have occurred.

Each time pictures were taken it was evident that the intervertebral disc between cervical v and vi had been seriously damaged and was disappearing. It is probable that the disappearance of this disc, especially in front, and followed by actual bony contact of the anterior lips of the two vertebræ, caused the failure to get a good reduction of the deformity by open operation.

The brace was kept on for a full year before the bony union occurred between the vertebræ because of the failure of his reparative processes and the consequent great risk of a serious recurrent dislocation with damage to the cord.

Right from the start, in spite of the recurrence of the bony deformity, there was steady improvement in the neurological disturbances, and after the first few months there was no evidence of nerve injury except the limitation in certain motions of the right upper extremity. By the end of a year even this had entirely disappeared and he has been and remained perfectly free from any symptoms of disturbance of the nervous system. At the present time he is in perfect physical condition.

He has free mobility of the head and neck without any discomfort. Apparently cervical v and vi are grown together sufficiently so they move as a unit.

DR. ROYAL WHITMAN considered these accidents not uncommon. In most instances the displacement was not sufficient to cause paralysis, the symptoms being stiffness and a disturbance of the torticollis type.

DR. JOHN DOUGLAS recalled a case that had come under his care in St. Luke's Hospital for fractured cervical vertebra about two years ago, a boy who fell with a weight dropping on him. When he was brought to the hospital the only signs were a stiffness of the neck and partial paresis of the left arm. X-ray showed fracture of the fifth cervical vertebra with dislocation of the fourth. A halter was made with two weights of seven or eight pounds, each swinging over the head of the bed on pulleys and extending the patient's neck. This was kept on for eight weeks and he was then put in a plaster cast, which was kept on for three months. One interesting thing about this young man was that he was a compensation case. Within the last two months Doctor Douglas was asked to examine him again, as he was still claiming disability. The X-ray showed a narrowing of the intervertebral disc and a narrowing due to compression of the anterior part of the body of the fractured vertebra. But there was no sensory or motor symptom or change in the knee jerks, or any other reflexes of the legs, arms or trunk. He complained of a subjective symptom: after leaning forward, when writing, for example, he grew dizzy. But as the physical examination showed nothing whatever abnormal, it was very difficult to report or determine how much permanent injury or disability this patient really suffered from.

DR. NATHAN W. GREEN spoke of a patient of his who had suffered a fracture dislocation between the fifth and sixth cervical vertebrae, as shown by X-ray examination. He was not brought to the hospital; he walked in, but with some stiffness of the neck and some paræsthesia of the internal surfaces of his forearms. He had a similar apparatus applied as in Doctor Douglas's case, but with twenty-six pounds traction on his head, the head of the bed was elevated and, after a stiff dose of morphine, this was left on all night with a pretty good reduction. Dr. P. W. Nathan, who was associated with the speaker in this case, brought in his mechanic and made a fine jury mast for the patient and looked after him after discharge from the hospital, with very good results. It is two years now since the accident and the man is apparently perfectly well.

DR. JOHN A. HARTWELL agreed with Doctor Whitman that these cases are not uncommon. They are seen quite frequently at Bellevue and have the typical deformity shown by Doctor Taylor's patient. The interesting fact about this patient is that he had no disturbance of motor activity of the arm during the first five days, and it only developed when he was up and about. This shows that the treatment of rest in bed is most essential because the erect position is always liable to produce additional disturbance.

## OSTEOMYELITIS OF THE FEMUR

DOCTOR TAYLOR, in closing the discussion, said that the impression that the patient had no motor symptoms in his arms until he was up and about was wrong. There was partial disturbance in both arms which increased up to forty-eight hours and then decreased until after a few weeks there was recovery. Doctor Taylor had considered that the case might be interesting as showing that a man's neck might be broken merely by wrestling. He agreed with Doctor Whitman and Doctor Hartwell that these cases are not uncommon and that they recover frequently. One reason there was so much difficulty in keeping the dislocation reduced in this particular case was the lack of reparative power evidenced by recurrent dislocations of patellæ and shoulder and by findings during operation; another reason was that the patient was erratic and uncontrollable at times. It seemed to the speaker that the thing that ought to be discussed was how long treatment should continue in cases of this kind. Ordinarily they are looked after for a few weeks. It is difficult to find a statement, with reasons, as to how long treatment should continue and what should be the criterion as to when treatment should cease. This patient had to be treated for a longer time, on account of lack of reparative power constitutionally, than would the ordinary case. Osgood said that in these cases the neck should be kept in an apparatus for one year, because he found in cases not so treated there would sometimes develop a thickening of the bone that would cause pressure on the cord. Doctor Taylor had seen cases where increasing deformity of the bone had caused progressive pressure myelitis of the cord which practically incapacitated the patient. He thought one ought to get good reduction at once and keep it by fixation.

## OSTEOMYELITIS OF THE FEMUR

DR. JOHN A. HARTWELL presented a young woman, eighteen years of age, with a request for suggestions as to treatment. The physical examination of the patient gives negative findings except for the right knee and thigh. The knees are asymmetrical, the right having a rounded appearance and the lower thigh musculature looking atrophic. Measurement shows the following:

	Right	Left
Infrapatellar .....	30 cm.	28 cm.
Suprapatellar .....	32 cm.	30.5 cm.
Three inches above patella .....	35 cm.	32.5 cm.
Seven inches above patella .....	40.5 cm.	39.5 cm.

Motion at admission was limited at the knee only, flexion being stopped at 50 degrees by pain. This has since in part cleared up, following rest in bed without other treatment. She cannot walk, as she cannot bear the weight of her body on the affected leg. There is slight tenderness over a very limited area in the medial epicondyle and just above the adductor tubercle. The lower femur feels definitely enlarged and irregular in outline. There is slight intra-articular effusion. The girl is healthy looking and has gained weight since being in the hospital.

The temperature has averaged 99°. On one day it went up to 103.8° without explanation other than the local condition. The pulse has averaged 100.

X-ray: Sinuses, teeth, cranium, lungs and long bones other than the femur, negative. There is shown no focus of infection. The right femur (Figs. 1 and 2) shows involvement of the entire diaphysis and lower epiphysis, marked by periosteal and endosteal bone production, destruction, involucra, sequestra, and cloaca. Contiguous joints are negative, except as stated above.

Blood: Two cultures have been negative. White blood-cell count, 11,000 to 19,000; red blood-cell count, 4,800,000 to 5,200,000; polymorphonuclears, 67 to 77 per cent.; hæmoglobin, 70 to 80 per cent.; sugar, 100 mgm.—100 c.c. Urine: always negative. Wassermann negative, and negative on four tests two days apart following provocative dose of salvarsan. Von Pirquet indeterminate.

The family history shows a probable tuberculous knee-joint in the father and a brother has tuberculous nodes in neck. The tentative diagnosis lies between tuberculosis and staphylococcus aureus osteomyelitis of low virulence.

DR. ROYAL WHITMAN thought the case one of osteomyelitis, the original focus being in the lower extremity of the femur, as indicated by the local sensitiveness and synovitis. The diffuse changes in the shaft he considered secondary and not unusual in cases of this character. He advised immediate operation to relieve tension and to remove the products of disease.

DR. WILLY MEYER believed that, inasmuch as thickening of the diaphysis is found in specific disease, and of the epiphysial region in tuberculosis, he would tentatively suggest this might be a case of early tuberculosis in the presence of hereditary syphilis.

DR. JAMES M. HITZROT agreed with Doctor Whitman that the patient should be operated upon. He regarded it as a low grade staphylococcic process beginning in the lower part of the femur, in the diaphysis. The periosteal proliferation he regarded as a result of the process in the lower end of the femur. He thought the lower end of the femur should be opened and the bone explored as far as it was diseased.

#### MASSIVE HYPERTROPHY OF BREASTS

DR. PARKER SYMS showed a young woman, age twenty-one, admitted to Lebanon Hospital November 28, 1921. Family history negative. The patient states that she was perfectly well until two months ago, when she noticed a small lump in her right breast. This did not cause pain, and she does not think it continued to grow after she discovered it. The patient was a normal, healthy individual. Menstruated at eleven, regularly since. She states that her breasts began to enlarge soon after she began to menstruate.

Examination showed a bilateral enlargement of the breasts. In the





FIG. 1.—Showing involvement of entire shaft. Note areas of destruction and of over-growth with probable sequestra scattered throughout.



FIG. 2.—Showing process in lower end of femur particularly involving the medial epicondyle. Note the periosteal over-growth in shaft.



FIG. 3.—Massive hypertrophy of breasts, showing site of tumor (sarcomatous?) which was removed.

inner upper quadrant of her right breast was an apparent fibro-epithelial tumor about one and a half inches at its longest axis (Fig. 3). It was for this condition that she entered the hospital, seeking to have it removed. On December 2, under local anæsthesia, this tumor was removed. It was not a distinct encapsulated tumor like a true fibroma or fibro-adenoma; it was like one of the pseudo-tumors that are found in cases of chronic cystic mastitis. He had, elsewhere, called attention to the fact that those are not tumors, but are simply a part of a general process. Like one of those pseudo-tumors, this could not be removed by enucleation or blunt dissection; it had to be cut across, showing that it was not a distinct or separate encapsulated tumor, but was a part of a general process in the breast.

*Pathological Report.*—Section cuts densely, seems to be made up of fibrous tissue.

*Microscopically*, shows numerous irregular swirls of spindle cells with fairly deep-stained nuclei. Some areas show many multinuclear giant cells, also considerable connective tissue present. There is also an increased amount of nuclear pigment present.

*Diagnosis.*—Fibro-sarcoma; spindle-celled type.

Notwithstanding the pathologist's report, he felt from the clinical point of view this could not be regarded as a sarcoma; so the patient has been kept under observation, and is presented to you to-night.

The breasts are evidently the seat of the same abnormal process; at any rate, the entire right breast was evidently the seat of the same process as the tumor-like mass which was removed; if that were clinically sarcoma, the rest of the breast should be also. Since the operation, there has been no growth, such as one would expect from a partial removal of a sarcoma. The breast and the region involved are about in the same condition as they were in, and he felt that they had been justified, in this case, in ignoring the microscopic findings. In rare instances these breasts undergo retrogression, but usually amputation is called for, the patient suffering from the weight and deformity and finally seeking relief.

Excessively enlarged breasts, within physiological limits, of course, are frequently met with. These cannot be considered pathologic, but occasionally breasts grow in size beyond the bounds of physiological development. These become a distinct entity, and may be considered under the term of massive hypertrophy of the breast. The most recent article on this subject was written by Linwood D. Keyser, of the Mayo Clinic. He briefly reviewed the literature and made a detailed report of four cases which had been recorded in the Mayo Clinic. According to him, race and climate have no bearing on etiology. Heredity has been mentioned as a possible factor in three instances. In 182 cases where the side affected was mentioned, 142 were bilateral and forty were unilateral. The duration of the process is extremely variable. Zurakow reported a case of a woman twenty-two years of age, whose breasts became hypertrophied, to a large extent, in the space of two and one-half months. The shortest period of growth in a patient under twenty-one was two

months, while the longest period was four years; while in women over twenty-one, the shortest period two and one-half months and the longest sixteen years.

Durston, who perhaps published the first authentic case of this disease in 1669, reported that the left breast weighed sixty-four pounds and the right one forty pounds. It was claimed that the entire process of hypertrophy took place within the space of one night. Porter records a case of the left breast weighing forty-three pounds and the right one seventeen pounds. Keyser states that probably the majority of breasts weigh in the neighborhood of ten pounds. In his recent article on this subject he gives the following summary:

1. "Massive hypertrophy of the breast is of two types: (a) fibroepithelial, and (b) adipose.

2. "It may occur between the ages of twelve and forty-eight, but is most frequently associated with puberty or pregnancy.

3. "The normal development of the breast seems to depend on the ovary, and there is evidence which strongly suggests that the massive hypertrophy may be etiologically related to an ovarian malfunction.

4. "If spontaneous regression of the process fails to occur, surgical amputation is, at present, the preferred treatment."

According to Keyser, Labarraque, in 1875, was the first to consider the subject of this matter in a scientific manner.

EXTIRPATION OF THE CERVICAL LYMPH-NODES, RELATED TO  
CANCER OF THE LIP

DR. GEORGE H. SEMKEN read a paper with the above title.

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## THE OPPORTUNITIES AND RESPONSIBILITIES OF THE SURGEON\*

BY JOHN M. T. FINNEY, M.D.  
OF BALTIMORE, MD.

OPPORTUNITY and responsibility are twin sisters and inseparable. The surgeon has unequalled opportunities to relieve suffering and to save life. His responsibilities are correspondingly great. Of him it can be truly said "he holds the life of his patient in his hand." No conscientious surgeon can escape the realization of this responsibility. Contrary to common belief, instead of becoming less keenly felt with advancing years and widening experience, the responsibility continually weighs more heavily in consequence of a fuller appreciation of the true significance of a surgical operation. Certain factors are concerned in every properly conducted operation; a carefully taken history, a thorough physical examination, and such special tests as may be requisite to a correct diagnosis; sound judgment, perfect asepsis, the necessary technical skill and, almost equally important, a properly directed after-treatment. In the carrying out of these details there are many opportunities for error which are often difficult and at times impossible to control. In order to guard against these as fully as possible, the utmost patience and care in carrying out the minutest details must constantly be employed. Hence, in dealing with problems of the gravest import to humanity, involving, as they do, health and happiness, life and death, there is required in their solution the application of unusual judgment and skill. The truly successful surgeon combines the qualities of self-reliance and initiative with experience and broad medical conceptions. However, there is little chance for us to become puffed up with pride and satisfaction, no matter how enamored we may be with our calling and our accomplishments, because we know too well our limitations and our failures. We like to think that surgeons are men of decision and action, accustomed to deal promptly with difficult problems, to overcome obstacles; resourceful, courageous, sympathetic, kind, and thoroughly human. But, at the same time, we are not blind to the fact that there are many ways in which our activities as professional men may be amplified and extended in order to make them more effective and more helpful to the general public.

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\* Presidential address, delivered before the American Surgical Association, May 1, 1922.

I venture to direct your attention to a general consideration of a few of these phases of our professional life.

We shall consider the opportunities and responsibilities of the surgeon under four headings, as they affect respectively the public, the patient, the profession, and the surgeon himself.

The subject chosen for this address may perhaps appear to be rather vague and general. However, after considering the various topics that appeared at all suitable for this purpose, none seemed quite so appropriate as a review of some of the opportunities and responsibilities of the surgeon which are more or less intimately concerned with his professional life. The time, the period of beginning recovery from the effects of the war; the place, the Capital of the Nation; the occasion, the Congress of American Physicians and Surgeons, all combine to direct our thoughts into channels other and wider than those strictly professional, and cause them to dwell for a moment upon matters of vital importance to the nation.

In the language of the familiar hymn, "We are living, we are moving in a grand and awful time." The world has just passed through the most profound political upheaval in its history. Social structures have been shaken to their foundations by wars and rumors of wars. Many individuals, groups and organizations of men, comprising in some instances the controlling forces of nations, have temporarily lost their orientation and are floundering in the quagmires of doubt and despair, or are futilely chasing will-o'-the-wisps of false doctrines and impractical theories of political economy and government.

One has but to look around in our own country as well as abroad, to see on every hand evidences of social unrest and mutual distrust between classes and nations. The gaunt figures of famine and pestilence are stalking abroad, in some portions of the world almost unopposed. Anarchy and agitation are here and there to be seen raising their ugly heads. It requires more than the average optimism to enable one to retain his equanimity and to contemplate the future with undaunted confidence.

This is the situation that confronts us as Americans, as educated men, members of a profession boastfully proclaimed by some as "the learned profession," a profession that has ever stood for the highest and best in human aspirations, whose idealism and altruism are its proudest heritage and its most distinguishing characteristics.

In a crisis such as confronts us at this moment, to whom is society to turn for aid and guidance? From what other source can a satisfactory solution of its manifold and perplexing problems be found than from its educated, thinking men? We as members of this favored class, to whom much in the way of opportunity has been given, owe much to society in return. In a strictly professional way we may have fulfilled this responsibility, some perhaps in large measure. But in the still larger sphere of good citizenship, of sharing in the responsibilities of government, of making our influence felt

upon the side of civic righteousness, we have, as individuals or as a profession, little to show in the way of accomplishment. We must plead guilty to the charge frequently made against us, namely, lack of interest. In response to a fine professional consciousness overjealously guarded, perhaps, we have stood too long aloof from active participation in public affairs, and have left to others, not always so disinterested, the management of civic matters, of great importance to us as individuals, to the communities in which we live and to the nation. How often have we stood in silence and acquiesced in unfortunate settlements of public questions when the proper solution could have been brought about by the aid of enlightened medical opinion. The time has arrived for us, as a profession, to forsake our exclusiveness and to enter more actively into public affairs; to make our influence felt in the decision of questions involving the welfare of mankind. The interests of medical men, no matter what their specialty, should be as broad as humanity itself, since they have so many points of intimate contact with the public. There are few civic questions that do not interest us primarily as citizens and in the settlement of which we are not concerned. There is nothing in our code of ethics to prevent active participation by physicians, individually or collectively, in public affairs, not directly as politicians (everyone abhors the political doctor), but as public-spirited men, representing a profession devoted to the service of mankind. The time is ripe for us to rededicate ourselves to that greater service and wider influence which is not bounded by a strictly professional horizon, but embraces the larger field of general human endeavor. It is our duty, in our respective communities, to take enough interest in public affairs to try to induce good men to accept nomination for public office, and in order to elect them, to go to the polls ourselves and induce others to do the same thing. Moreover, it should be our concern to see to it that our representatives in office live up to ante-election promises and really represent us.

Impotent in our splendid isolation, we have from time to time watched our representatives shamelessly prostitute their high offices for private gain, without lifting so much as a finger to prevent wrongdoing or to assure square dealing. Yet all the while we are deploring existing conditions and the lack of intelligent public opinion which would render such things impossible. Physicians should exert their moral force by actively interesting themselves in municipal, state, national and international affairs, not casting precedent entirely to the winds, but, on the other hand, not so firmly bound by it as to prevent them from taking their proper place in society and accepting and discharging their full share of the responsibilities of citizenship.

There is no scarcity of problems to engage the attention of professional men and women. Barker, in a recent address, discusses "The Wider Influence of the Physician." He points out that "one good of the great war was to emphasize sharply again that not only each one of us but each group of us is not separate from, nor wholly independent of, other persons and other groups, but must, of necessity, affect them and be affected by them, since all

individuals and all groups are but parts of one great whole, the world of men and the onward movement of life. Physicians at least as quickly as any other group will accept realization of self in the service of society as their ideal of personal success. In order to achieve the highest self-realization and the greatest social service, each member of society, besides doing some particular kind of work especially well, must actively and heartily participate in common life. Those physicians and surgeons will do most to promote the advance who first do the best practical, technical work of which they are capable, and, secondly, exert their influence, wherever possible, toward the better organization of society as a whole."

There are many problems now engaging national and international attention in the solution of which the medical profession could render service of incalculable value to mankind. The weight of its united opinion could, for instance, satisfactorily determine the settlement of public health measures now under consideration, *e.g.*, the supervision and control of food supplies, urban and rural sanitation, child, school, personal, social and industrial hygiene, to which may be added many kindred subjects that affect community life, even the much vexed question of the enforcement of prohibition. Moreover, medical men disinterested as they are, seeing as they do both sides, could help greatly in bringing about between employers and employees the mutual understanding and open dealing needed to insure industrial peace and progress. This list of opportunities might be extended almost indefinitely. However, one other question only will be mentioned in this connection because it intimately concerns all individuals in all nations. It has to do with the prevention of future wars by a just settlement of the problems growing out of the late war.

Members of the medical profession entered the service during the war more largely than did those of any other profession, and have for this reason fairly earned the right to be heard. Moreover, through experience and observation they alone can tell the full extent of the mental and physical disabilities caused by war, and the terrific human wastage resulting therefrom.

What more effective indictment could be brought against war and its attendant barbarities than that which could be drawn up against it by the medical profession? Fortunately, the world conscience is seemingly at last becoming aroused and tardy efforts are being made, as shown by the recent peace conference held in this city under the auspices of our own government, to retrieve in some small measure what was the real tragedy of the war so far as we as a nation are concerned, namely, the failure, from whatever cause, of our country to assume the leadership of the world in establishing the principle of righteousness in all international relations, which is the only sure foundation for a just and lasting peace.

By common consent, at the present moment there is no question confronting the world that concerns so intimately every individual in every nation as a proper and just settlement of the many perplexing questions growing out of



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the late war, and the institution of effective measures to prevent a repetition of its horrors. In the final analysis, the medical profession is in a position to wield a powerful influence in moulding public opinion in favor of universal disarmament and the establishment of the principle of arbitration by agreement between nations, thus doing away with the necessity for the continuance of huge armies and navies. Meanwhile, common prudence demands that we, as a nation, maintain a reasonable degree of preparedness, so long as other nations continue active preparations for war. Personally, I should like to see this Association of the leading surgeons of the country go on record as favoring those principles embodied in the League of Nations, the Quadruple Agreement, or in whatever form, so long as we surgeons, occupying the position that we do, go on record as actively identified with and heartily supporting this movement. For just as sure as the night follows the day, so surely will we or our descendants, in spite of narrow-minded politicians, reactionary senators and other obstructionists, yet see the day when the civilized peoples of the earth will be brought together into a society of nations, call it by whatever name you will, and this cruel, hateful thing that we call war, with its attendant appalling loss of life and limb will have been superseded by a less barbarous method of settling international disputes. But they say this is Utopian, idealistic, impossible of accomplishment. Nothing is impossible when public sentiment becomes sufficiently aroused in its support. The same thing was said of duelling, of equal rights for women, of national prohibition, and a hundred other things whose accomplishment has long since become an established fact.

I have dwelt thus at length upon this phase of the subject under consideration, indulging the hope that that magnificent spirit of unselfish devotion to country and to humanity which so characterized and controlled every activity during the recent war, may be again revived in all of its unselfish glory, and so inspire the minds and hearts of all good citizens, including the members of our beloved profession, that they may cast off the shackles of ultra conservatism and professional isolation and rise to the full heights of leadership in affairs other than those strictly professional for which, by training and by influence, they are preëminently fitted.

What the world needs to-day in order to lift it out of the terrible state of disorder and unrest in which it finds itself is the leadership of men of vision, with high ideals, unselfish, with faith in God, in mankind and in the future; men of discernment who have learned in the school of life that most important of all lessons, namely, that the only permanent solution of the grave problems, both national and international, with which we are now confronted is the practical application of the principles of the golden rule; who know that the only way in which to overthrow and permanently overcome the forces of evil is by supplanting them with something better, and who have the initiative and the ability to carry out their ideas. Their war and peace records show that the Fellows of the American Surgical Association possess these qualities. Thus far our leadership has been largely directed toward the

advancement of surgery. May we not now devote our attention and energies no less in this special direction, but be willing so to extend our sphere of usefulness as to include active coöperation in civic and national affairs? Those splendid lines of J. G. Holland apply here with especial force:

"God give us men! A time like this demands  
Strong minds, great hearts, true faith and ready hands,  
Men whom the lust of office does not kill;  
Men whom the spoils of office cannot buy;  
Men who possess opinions and a will;  
Men who have honor and who will not lie;  
Men who can stand before a demagogue  
And scorn his treacherous flatteries without winking.  
Tall men, sun-crowned, who live above the fog  
In public duty and private thinking."

The responsibility of the surgeon to his patients demands that he should fit himself in every way possible to render the most beneficent service to those who entrust themselves to his care. Every surgeon appreciates the greatness of this demand in these days of rapid development along so many lines. Even with constant reading, there is such a mass of new material continually accumulating that it is impossible for a busy man to do his work and at the same time keep up with the literature. A satisfactory solution of this problem remains to be found, although various remedies have been offered in the shape of literary abstract bureaus, journal clubs and the like.

Although the necessity of keeping abreast of continuous advances in medicine and surgery is burdensome, the opportunities presented to make real contributions to medical or surgical science were never greater. New vistas are being continually opened as knowledge advances. Think of the many problems awaiting solution in the special field of surgery. Take, for example, just one, that of cancer. No greater service can be rendered mankind than the discovery of the cause, prevention and satisfactory treatment of this great scourge. The stimulus furnished by the joint responsibility and opportunity that are ours should urge us to utilize our time and talents to the utmost in order that individually and collectively we may contribute more than our quota to progress and achieve even higher standards than those set by our predecessors.

The surgeon, if he would but make the effort to gain the confidence of his patients, may render needed service other than strictly professional. He may, for instance, share the burdens inseparable from a surgical operation; he may help to relieve the nervous strain and apprehension associated with entering a hospital as a patient. By the exercise of tact and consideration, he can lessen the dread of the operating-room and anæsthetic, often more formidable than the operation itself. Likewise the shock of bad news concerning unfavorable operative findings and results may be softened and minimized. Such opportunities as these and many more are being continually presented to us to render invaluable service to those in need. Too often the science and art

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of surgery so engage our attention that there is little time left to give to the development of the more personal side. Surgeons are so engrossed in operating-room and hospital, in office consultations and in their daily rounds, that little time or thought is given to other and less conventional aspects of professional life. Let us never forget that a surgeon's whole duty is not done when he sends a patient home with a healed wound. It is possible to have as an end result a perfectly healed wound and permanently impaired function. The war taught us, if it taught us anything new in surgery, that restoration of function is one of the most important parts of the surgeon's duty. It is not enough simply to see and perfunctorily to examine a patient as just another more or less interesting problem to be solved. The true surgeon as a lover of his fellow-men will not be content to view his patient from this standpoint alone and then mechanically to operate upon him and let it go at that. He will render whatever additional aid and comfort may be in his power. These so-called little things are often really the big things, those that truly count, and which in the last analysis go so far toward making life worth the living for both the patient and the surgeon. It is a pity that we think ourselves too busy to improve opportunities to render little personal attentions to patients and their friends that are frequently remembered and valued long after the more showy professional services have been forgotten.

Few surgeons are competent to carry out satisfactorily all the details involved in modern surgery. The increasingly complex character of the surgeon's duties compels specialization if he wishes thoroughly to master any particular branch and thus be able to give the best service to his patients. The diagnostic clinic has come into being in response to this demand. Coöperation and group effort in some form are essential nowadays to make a complete diagnosis and to meet therapeutic requirements. Here is another responsibility of the surgeon, satisfactorily to work out his part in this comparatively recent development. Group medicine has come to stay. It has many possibilities for good, but it has equally great possibilities for evil, many of which already are being realized. The future must determine how best to regulate and control this new phase of practice.

The patient has the right to expect of his special surgeon more than average knowledge and ability. The surgeon, if he would meet these requirements, must be a leader, not a follower. He should never be content with mediocrity. Incessant effort is required in order to make this possible. It can be accomplished only by close observation of the work of other surgeons, obtainable by visiting their clinics, by reading, meditation, studies in laboratory, ward and clinic, and by regular attendance upon medical and surgical meetings. All are time-consuming and tend to prevent desirable participation in civic and other important duties and to curtail greatly the time which one might otherwise spend to his own and his patient's satisfaction and benefit in the more human side of professional activities.

In spite of all the difficulties that beset the surgeon's pathway and his

many worries and disappointments, there is none with whom he would be willing to exchange places, because no other profession offers comparable opportunities for personal service. In view of what surgery has been able to accomplish in the past and the wonders it can perform at the present time, like the pilgrims after their glimpse of the celestial city from the top of the delectable mountains, we should proceed hopefully in the prospect of still greater triumphs yet to come in the science and art of surgery, as the result of our labors and the labors of those properly trained by us to be our successors.

Among the more pressing of the immediate responsibilities resting upon the surgeon is that which involves the progress and development of his own profession. This cannot be dissociated from those other responsibilities of which we have been speaking because the interests of the patient, the profession and the surgeon are merged into those of the public. Whatever makes for the welfare of the one is intimately concerned in the welfare of all. Hence it is that we, as a profession, are vitally concerned in any proposed radical departure from generally accepted educational methods. The position of teachers and other leaders of surgical thought and practice with regard to changes and innovations in established modes of teaching should be neither reactionary nor too eager to accept unchallenged and as ex-cathedra proposed changes because they happen to emanate from apparently authoritative sources. It stands to reason that surgeons are best qualified to judge of the methods of teaching surgery. It is too early as yet to determine whether or not the strictly full-time plan will prove best for the teaching of surgery and other clinical branches. From the general proposition that the incumbent of a chair of surgery should devote his principal time and attention to teaching and to investigation, there can be no dissent. But will the best results be achieved by requiring professors of surgery to devote their entire time to departmental administrative work, to teaching and to research, to the practical exclusion of other outside interests? Upon this point there is room for decided difference of opinion. Indeed it is a question whether teachers in the non-clinical departments would not be the better for more frequent extra-mural contacts and greater personal competition.

Both from the standpoint of the teacher and the student there is a reasonable doubt about the ultimate effect of this method of teaching surgery. There is a well-grounded conviction in the minds of many competent to judge of such matters that the full-time plan, if followed rigidly, will have a narrowing effect upon those trained under it and will tend to develop the cloistered, institutional type as distinguished from the broad-minded man of affairs which has hitherto characterized the surgeon. Let us not be hypercritical, but retain an open mind and a receptive attitude toward any possible advance or improvement in present methods. We would be recreant to our trust if we did otherwise.

There is a responsibility resting upon the public as well as upon the pro-

fession, an obligation that devolves upon both individuals and corporations that have amassed wealth to devote a portion of it to promote the study of disease and the advancement of responsible agencies engaged in the care of the sick and the relief of the suffering, such as hospitals, medical schools, research institutions and the like. The particular methods to be employed in the carrying out of this work should not, in consequence of these benefactions, become the object of dictation or control. However groundless may be the fear of such interference with institutional and academic freedom, unfortunately the impression has been created that there is danger lest in this way medical education may be too strongly committed to a course of action as yet only in the experimental stage and of which insufficient opportunity is as yet available to enable us to judge as to its real merit. By all means let us welcome assistance from every source and by its aid endeavor to advance medical education in general and the training of competent surgeons in which we are more especially interested, but let us not accept as a principle for universal application any new proposition until it has been thoroughly tested in institutions sufficiently well endowed and equipped to pass final judgment upon the experiment. Therefore, before committing ourselves to any revolutionary action in regard to medical education and surgical training, let us weigh carefully the opportunities that it offers for both good and evil, balancing the one against the other and be sure always to follow the Biblical injunction "prove all things, hold fast that which is good."

There is real danger lest in our zealous search after truth we may lose our perception of relative values and unduly stress one branch of knowledge to the detriment of others of perhaps equal, or even greater, importance. In that charming address, the last and one of the best of the many scholarly and delightful poems in prose that he has delivered, entitled "The Old Humanities and the New Science," Sir William Osler traces their interrelationship and makes clear the lack of conflict between them. In his inimitable style, he establishes their mutual dependence the one upon the other, if the best results are to be obtained, and indicates how the trend in modern liberal education is toward a closer union between humane letters and natural science.

In the broader and more humanitarian sense medicine is an altruistic profession. In the last analysis, this quality plays an important part in all professional activities. It controls the various relations of the surgeon to society. It determines his responsibility to his patients. Science, on the other hand, is impersonal. It deals with things, with problems, with facts, only incidentally and more or less remotely with people. From the direction which the newer and more scientific developments in medicine are taking, there is grave danger that the increased emphasis placed upon this important phase of the education of the doctor may cause the humanitarian and altruistic aspects of the subject to fail to receive due consideration. There is much in medicine besides scientific interest in the patient. There is something of value in the training and equipment of the doctor that science does not supply.

Let us see to it that the proper balance is maintained between the scientific and the humanitarian aspects of the subject.

Just what constitutes research and just how important a rôle it should play in the curriculum of the medical school are questions of prime importance. Relatively greater value is being attached to it now than ever before, and rightly so. The danger that confronts us as teachers, however, is that we may again lose our sense of proportion and magnify this one important function of the medical school at the expense of others. It should at all times be borne in mind that the most important function of the medical school is the training of public servants, the making of good doctors. If a list were to be made of the more evident tendencies of present-day medical education, it would include the glorification of research, the increased emphasis placed upon the allied sciences, chemistry, physics, biochemistry, etc., and the paying of less attention to the fundamental subjects of anatomy, physiology, pathology, bacteriology, therapeutics, etc., and the apparent leaving out of account the human element in the training of the medical student, in short, more theory and less practice. Have we not here a confusion of two ideas, namely, that of the medical school proper and that of the research institute? Are we quite fair to the student in failing to give him a sufficiently thorough background before expecting of him scientific research for which he may have no natural aptitude or may never become properly equipped?

The ultimate effect of this ultra-scientific development upon the profession will undoubtedly be to raise the general standard of intelligence. Physicians as a class will be better acquainted with the allied sciences, perhaps more highly educated than at present, but will they be better doctors? Will they be better able to diagnose and to cope with disease in all of its protean manifestations and to deal with correlated problems of patients wherein friendly interest and advice are often of equal or of even greater importance than attention to physical ailments. Are we not already overeducating our medical students in some respects, and may it not be that we are demanding too much of them? May we not be attempting to cram too much into their heads in a given time, so much, in fact, that they are unable thoroughly to digest it? The inevitable result is that many of them are being turned out of our medical schools with a mass of unassimilated, incoördinated facts, which they do not fully understand and cannot properly use. They are frequently unable to distinguish the really important from the unimportant; attempting to make original investigations when they are unable to recognize and correctly interpret many of the most common and familiar phenomena of disease. Doctor Osler, in the address previously cited, in referring to the extraordinary development of modern science and the consequent necessity for specialization, says: "Applying themselves early to research, young men get into the back waters far from the main stream. They quickly lose their sense of proportion, become hypercritical, and the smaller the field, the greater the tendency to megaloccephaly." This explains many of the inferior contributions appear-

ing in medical journals and masquerading under the guise of research. The fact that a certain series of operations was done upon dogs, does not make it scientific research any more than does the fact that another series done upon human beings prevents it from being classed as such. It all depends upon the circumstances under which each was done. The proper mental attitude, the scientific spirit and approved methods are all that is necessary to transform ordinary surgical routine into real investigation. As thinking medical men, teachers of surgery in our respective schools, it is our duty to foster research by stimulating the scientific curiosity of our students by the character of our own teaching and work and then suggesting to them ideas for further study. We should observe our students carefully and select out the few who have the true investigative spirit and the necessary persistence in order to take advantage of it, for they are indeed *rara aves*. Encourage these in every way and do not hamper them with conventional restraints. True genius never pulls well in double harness but does best when going alone. Cultivate and nourish the real investigator as you would a hothouse plant. In this way, by developing and making more productive the individuals specially endowed by nature, research can be better encouraged and greater progress be made than in the vain attempt to make investigators out of all students. The average student who makes up the mass of the profession can be well trained to take care of the sick. He can, at the same time, be given the right attitude of mind toward work, study, thought, research and the manifold opportunities and responsibilities of the profession toward society, and last, but not least, he can be taught his true relation to his patients, namely, that of service.

Let us, teachers of surgery, responsible for the proper training of students, strive to maintain in the curricula of our schools the proper balance between the science and the art of medicine and not make the mistake of diverting our medical schools from their legitimate function. Much of the difficulty in medical education to-day is attributable to the lack of a thorough understanding between those working in non-clinical and clinical departments. If each group would take the trouble to acquire an intelligent and sympathetic interest in the problems and the aims of the other, they would meet upon common ground to the mutual advantage of each, and so hasten the discovery and application of more effective means to combat disease. The fictitious barrier now existing between them would then quickly disappear. No one whose interests are purely scientific to the exclusion of the humanitarian should be in a medical school. His place is in a research institute. No one whose interests are purely commercial should be in medicine, his place is in business. Medicine has one big job, the prevention and alleviation of disease. Medical schools should devote their efforts to training those capable and willing to do this job.

When a medical student has been taught how to observe accurately, how to work honestly and what is the proper attitude of mind toward his fellows,

both professional and lay, he may be safely trusted to work out his own salvation with the assurance that the best interests of the patient, the public and the profession will be safeguarded. The student so instructed will sooner or later find his proper level. Either the science or the art of medicine, or both, will claim him in response to the leading of the spirit that moves within him.

There is an outstanding evil of which we are all only too fully cognizant and that should be remedied. Public safety and the good name of the profession demand that the pernicious activities of daring but unprincipled operators who are attempting to do surgery without sufficient education or training should be curtailed because of the disastrous results inflicted by them upon their patients. You and I know how active they are, for we are being constantly called upon to repair the damage that they have done, not infrequently amounting to permanent disability or loss of life. It is an unpleasant task to wash our dirty linen in public, but our responsibility to our fellow-men and our regard for the good name of our profession require this Association to take some action, looking toward the solution of this unpleasant problem. The American College of Surgeons has already made a beginning in attempting to elevate the standards of surgery among its Fellows, by establishing certain requirements for membership, standardizing hospitals and in other ways. The Council on Medical Education of the American Medical Association has also done excellent work in this direction. But these organizations, working independently, cannot accomplish the desired result. Team work, the united and sustained effort of all responsible organizations will be necessary to accomplish results. Upon a former occasion, I have emphasized the evils of ill-advised and poorly-executed operations by untrained surgeons, especially in poorly-equipped private hospitals, where the worst execution is done.

Every one of us is aware of this fact, and there is no need for further elaboration here. These evils are sufficiently glaring and urgent to demand action by the responsible surgeons of the Nation. The chief evils referred to are: (1) That anyone licensed to practise medicine in any form may set himself up as a surgeon and operate upon anyone sufficiently ignorant or foolish to permit him to do so; (2) there is no properly constituted national authority to determine a candidate's fitness to practise surgery, to grant him a license or to supervise his work, and in case of sufficient cause, to cancel his license and prevent him from further operating.

Perhaps it is neither feasible nor desirable to exercise too close supervision, but some remedy can and must be found for existing evils. It is better that the initiation and supervision of necessary reforms should come promptly from the profession, or else the State may see fit to take the matter into its own hands and give another sorry exhibition of ill-advised action by well-meaning but misguided authority.

Organized effort is needed in order to bring about effective action. After mature deliberation, I would recommend that this Association appoint a com-



mittee and request the appointment of similar committees by other representative bodies of surgeons and medical schools for the purpose of holding conferences to devise effective means of controlling the practice of surgery in the United States. In making this recommendation, we are well aware of the fact that at the present time, the educational facilities and the machinery necessary to remedy these evils are non-existent. But we are equally convinced that after a thorough study of the needs of the situation, a satisfactory plan can be devised by means of which prospective surgeons may receive adequate training under proper supervision and be properly certified to before beginning the practice of surgery.

What shall we say with regard to the opportunities and responsibilities of the surgeon as they primarily concern himself? This is an aspect of the subject that is usually given scant consideration. The surgeon, like his medical brother, is notoriously negligent, even reckless of himself, his interests, his health, his means, and at times even of his own reputation where that of his patient is concerned. In his zeal to fit himself and to keep himself fit to render service to his fellow-men, he forgets self and disregards the ordinary laws of health, which, added to intense mental and physical strain, tend to impair his usefulness and ultimately shorten his life. All of us are constantly offending in this respect.

Compared with other professions, the life of the surgeon is short. None but he knows the weighty responsibilities that he has to bear, the haunting fears and misgivings inseparable from his work, the questions of grave import that he is called upon to decide, frequently without opportunity for deliberation or consultation. How may the surgeon best conserve his time and energy? There are many ways in which this may be done. One only will be mentioned, it is the cultivation and practice of system in one's work. Nothing is more destructive of accomplishment than the lack of it. Listen to the words of Sir William Osler: "How can you take the greatest possible advantage of your capacities with the least possible strain? By cultivating system. I say 'cultivating' advisedly, since some of you will find the acquisition of systematic habits very hard. There are minds congenitally systematic, others have a life-long fight against an inherited tendency to diffuseness and carelessness in their work. A few brilliant Fellows try to dispense with it altogether, but they are a burden to their brethren and a sore trial to their intimates. I have heard it said that order is the badge of an ordinary mind. So it may be, but as practitioners of medicine, we have to be thankful to get into that useful class. Let me entreat you to take to heart what I say on this matter. Forget all else, but take away this counsel of a man who has had to fight a hard battle, and not always a successful one, for the little order that he has had in his life; take away with you a profound conviction of the value of order in your work."

These words were addressed to a class of medical students, but they also apply with equal, or even greater force, to us students of a more mature

growth, though I fear that for some of us at least the advice has come too late and will fall upon the deaf ears of habit-ridden men, confessing their sins, but like Sindbad with the "Old Man of the Sea," unable to throw them off.

A proper apportionment of our time between work, reading, study, investigation, meditation, travel, recreation, activities other than professional, etc., if consistently maintained, will result to an astonishing degree in increased productivity. One has but to look around among the Fellows of this Association in order to observe the beneficent influence of orderliness and system. And this is not all. I am sure we have all been impressed and stimulated, as we have followed our daily round of duties, by the unlimited opportunities as well as the grave responsibilities that are ours. We have also been impressed, too, no doubt, many times by the consciousness of how far we have fallen short of taking advantage of these opportunities, and how frequently we have failed to accept fully the responsibilities that are ours. On the other hand, it should not be forgotten that talent and capacity vary widely in different individuals as does opportunity. It is not what one has to start with that matters so much, as what one does with what one has.

"It's not the hand Fate deals you that counts in the game of life,  
 Mayhap born to poverty, to sorrow, toil or strife;  
 Or mayhap born to luxury and petted to beat the band.  
 It isn't the hand Fate deals you, it's the way you play your hand."

How often, in the course of our professional activities, have we not had the opportunity, indeed the privilege of observing consummate courage and fortitude displayed by some patient or loved one who cheerfully, with a smile on the face, has bravely fought to the finish a losing fight? Who has not been made a better man by such experience?

How far the opportunities and responsibilities that come to us all in varying measure may be met and taken advantage of is well illustrated by the accomplishments of one whose labors have only recently come to an end, one whom we are proud to claim as an Honorary Fellow of this Association, Major General William Crawford Gorgas, Medical Corps, United States Army. By his great work in the control of malaria, yellow fever and other tropical diseases, he has saved untold lives, rendered habitable large portions of the earth's surface and made possible the completion of that colossal undertaking, the Panama Canal. It was my privilege a year or two ago to be present at the wonderfully beautiful and impressive services held in Old St. Paul's Cathedral in London in honor of that great surgeon, splendid character and brave soldier. The signal honor accorded his memory and the recognition of the value of his work by the King of England and the English people were well deserved and will long be remembered by a grateful profession and nation. Such a career lies open to but few, because the one talent men are far more numerous than the ten, but such an example may well serve as an incentive and a goal toward which all may strive. The point of the whole

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matter is this, to be faithful in the few things or the many, to use well our one talent or our ten, to employ to the greatest advantage to humanity what we have, and then in the final reckoning it matters little whether we are classed in the one group or the other, we will have left mankind our debtor, we will have rendered some real service to our fellows, we will have made the world a better place for our having lived therein.

So, casting aside all disquieting regrets for the past and undisturbed by the uncertainties of the present, looking steadfastly into the future, let us take courage and, in the spirit of Ulysses, advance with confidence.

"Death closes all; but something ere the end,  
Some work of nobler note, may yet be done.  
'Tis not too late to seek a newer world,  
Push off, and sitting well in order, smite  
The sounding furrows, for my purpose holds  
To sail beyond the sunset, and the baths  
Of all the western stars, until I die."

## END RESULTS IN CANCER AS INFLUENCED BY TYPE, REACTION, LOCATION AND AGE\*

BY CHARLES H. MAYO, M.D.

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CANCER is the most dread disease of modern times, although as old as history. More of our citizens are destroyed by cancer in one year than were destroyed by our two years of war; the disease selects its victims, however, from the mature and aged rather than from the youth of the nation. Cancer apparently is increasing at a rate of about two and five-tenths per cent. a year. We have saved lives in infancy by preventing disease and thereby increased the number of persons who reach cancer age. The greatest loss from cancer is between the years of forty and sixty. Within the age limits of forty-five and fifty more women are afflicted than men, while from the sixtieth to the seventy-fifth year more men have the disease; that is, approximately three women are affected to two men, the difference being in the involvement of the organs of reproduction.

Within the last few decades continuous discussions of the cancer problem with reports from various investigators have greatly augmented our knowledge of the subject, and while the cause is still a moot question, it must necessarily be a force that will harmonize in all of its manifestations wherever found.

Cancer is found not only in man but in all manner of life, animals and plants; thus loss of function, and uncontrolled proliferation and migration of immature cells appears generally throughout nature. The disease and its destructive effects are so well known that the public is being educated with regard to it. Men with tumors and ulcers of the tongue and women with tumors of the breast are consulting physicians so much earlier than formerly that more than fifty per cent. of the lesions are found to be benign, and early treatment saves many persons from developing cancer. Undoubtedly also many lives are saved or prolonged even though the number of accessible, recognizable, or visible cancerous growths are in the minority.

Most investigators of cancer have been stimulated by preconceived ideas which they endeavored to prove. Brief reviews of hypotheses of cancer development are presented, that attention may be directed to the fact that these hypotheses harmonize more than might be expected if in each is considered a condition contributing to a local chemistry favorable to cell growth with other factors, such as environment and loss of cell control in one or several cells.

Environment and, apparently, acids are contributing factors in cancer.

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\* Read before the American Surgical Association, May 1, 1922.

More than one-third of the cancers in men, and somewhat less of those in women, are found in the highly acid stomach; the acid large bowel is often affected with cancer, while the alkaline small intestine is but rarely affected. Acids due to degeneration, normally as in the reproductive organs, or abnormally, especially those due to degeneration of lipoids, and those due to irritation, are contributing factors.

As a result of the investigations of pathologists and biologists who have made a study of cancer, many hypotheses have been reported. It is doubtful if the world would be better off or the disease better handled could we temporarily accept any one hypothesis to the exclusion of others, which is now the viewpoint and hope of the public, derived, apparently, from the medical profession. The views of these investigators seem to harmonize in acceptance of regression or degeneration of the cells, of loss of function, and of proliferation, as processes in cancer, and of irritation as a factor either physical or chemical. Within the last few years a dissenting group of pathologists has disputed this generally accepted hypothesis and believes that it is not the functioning cell which starts cancer by degenerating or regressing but the immature, waiting, or repair cells of the embryonic type. The loss of cell control for the misplaced group is the factor in Cohnheim's theory of embryonic misplacement, in which group tissue control is placed with function, although this is only a possible factor, for benign tumor development is rarely seen and is unsatisfactory as an explanation of changes which occur in single cells. Moullin believes cancer starts in a single cell, although there is no reason to believe that several cells in the same area might not receive the same stimulus with like result. Waldeyer and Thiersch considered the loss of control to be due to the exhaustion of cells as a result of age, while Ribbert believed the loss of control to be due to isolation of the cells by inflammation, which is usually considered of bacterial origin. Ochsner voices the belief of many, in saying that the cause is undoubtedly the result of microbic action. Bacteria as an irritant should be considered in the light of their chemical output and not alone by their presence. Febiger has apparently caused cancer of the stomach in rats by giving *Spiroptera neoplastica*, and Smith in the development of plant cancer, crown gall, causes it by injecting *Bacillus tumefaciens*; he can also develop such growths by chemical irritation.

In considering the causes which stimulate cell growth we are reminded of the work of Jacques Loeb who fertilized sea-urchins' eggs by placing them in one per cent. butyric acid and sea water for one minute and then returning them to sea water, a positive evidence of the effect of chemicals in stimulating proliferation of cells. While several factors may have their place in the development of cancer, or may be considered essential, such as age, exhaustion of the cell, and loss of function and control, the chemical environment, however developed, is undoubtedly a most important stimulating force. The cells

of youth are resistant to cancer, but if once affected, the softer tissue and better circulation, vascular and lymphatic, render growth and metastasis more serious; thus, in a man of thirty-five years, cancer of the lip would make as much progress in a few months as a similar growth in two years in a man of eighty.

From the clinical standpoint great progress is being made in attacks on cancer. First, the publicity concerning the disease is resulting in a higher percentage of early operations. Second, the operations are more radical, or if radical operation is impossible or inadvisable, palliative operations with Röntgen-ray or radium treatment check the activity of growth.

Röntgen-ray and radium in the treatment of cancer have made marked progress in a very serious group of cases. When this form of treatment was first undertaken only those whose condition was too far advanced for surgery were considered suitable subjects.

The action of the Röntgen and radium rays on the malignant cell is identical, provided their wave-lengths are equal. The most penetrating rays of radium represent an electrical potential equal to 3,000,000 volts, while our latest transformers have a capacity of only 300,000 volts. In the treatment of malignancy, especially in the cavities of the body, radiation therapy is most effective when radium is applied directly to the tumor and Röntgen-rays to the possible regional and deep metastatic areas.

The action of the ray causes a complex physiochemical change in which the cell becomes œdematous, the nuclear substance fragments, and finally all powers of cell regeneration are lost; the débris is carried away by phagocytosis and replaced by connective tissue.

Many early and some late cases, according to location and type, have apparently been cured by such treatment. When vascularity is one of the features of the condition radium is most excellent. The end-result of both Röntgen and radium therapy is the development of fibrosis, which often changes the type of malignancy.

From the standpoint of the pathologist most important advances have been made. The immediate frozen section gives, within two minutes after removal, a true picture of the disease without chemical or embalming changes of tissue. Resistance to the growth is shown by lymphatic infiltration and round-cell activity which indicates the development of fibrosis, the extent of which gives more or less evidence of the results of this action and shows it to be one of persistence probably even from the inception of the growth. On the other hand, there may be no evidence of fibrosis, but a very active cellular growth with proliferation, a most fatal type, especially if not recognized and operated on early before the lymphatics are involved. The possibility or rather probability of the cure of cancer can be largely foretold by the pathologist: thus two individuals of the same age with cancer of the breast, stomach, or rectum,

## END RESULTS IN CANCER

of the same period of growth, with the same extent of apparent glandular invasion, would have prospects of life following the same operation, very largely according to the presence of fibrosis in the one and its absence in the other. Mass evidence may be secured by investigating the late results of operation for cancer after years have passed, by means of slides, and preserved specimens of those who have died and of those who have remained well. If the evidence is there, the surgeon must divide the honors of success and the dismay of failure with nature's efforts. In the Clinic, MacCarty and Broders have found the later results following operation for cancer to tally very largely with the cell evidence.

## THE SECONDARY MANIFESTATIONS OF MALIGNANT DISEASE\*

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THE vagaries of the secondary manifestations of malignant disease are so remarkable one is puzzled, at times, to understand the laws which govern their development. The metastatic growths, often situate close to, or at a remote portion of the body from the primary growth, and occurring at varying intervals of time after the initial appearance or removal of a malignant tumor, form the immediate subject for discussion in this paper. The clinical application of known facts regarding the development of these secondary tumors becomes a matter of great importance in practical surgery. It is essential to study the more unusual manifestations of secondary growths; in many instances the key to the solution of a difficult problem in the life history of specific disease is found in the more or less exceptional case.

*Metastasis Through Lymph Channels.*—Secondary growth through lymphatic channels presents great variety in cancer of the breast. The clinical demonstration prior to operation of the existence or otherwise of invasion of the axillary lymph-nodes, may be impossible. On the other hand, the secondary tumor or tumors may not only far exceed the primary in bulk, but may become apparent before the primary tumor in the breast is discovered. Thus in a woman of forty-three a glandular growth was removed from the axilla which proved to be malignant: there was no evidence of tumor in the breast; ten months subsequently this woman again presented herself with a scirrhus cancer of the breast, some areas showing a medullary type, with additional cancer nodes in the axilla. The reverse of this picture was shown in a woman of seventy who had a tumor in the breast for six years. A radical operation was performed on a diagnosis of cancer. Scirrhus cancer was found in the breast, but the axillary glands, although enlarged, were entirely free from malignant development. In such cases the prognosis is good and this patient has remained free from recurrence after the lapse of four years.

Sampson Handley made an important contribution to this subject in his investigations regarding the secondary manifestations of breast cancer. His work, which is familiar to all those interested in the subject, was first presented in the Hunterian lectures before the Royal College of Surgeons in 1905; subsequently he published more extended observations in book form. He enunciated the view of continuous extension of growth along lymphatic channels and termed it "lymphatic permeation." This view was opposed to the "embolic" theory of the origin of secondary growths. His findings may be summarized as follows: He demonstrated continuous extension of cancer cells along lymphatic channels to the glands of the axilla and to the infra-

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clavicular and supraclavicular groups. He also traced a continuous chain of invasion to the pleura, the lungs, and to the opposite breast. He similarly accounts for bone metastases in the humerus, the ribs and the spine. Perhaps his most interesting observation is the invasion of the lymph channels from the breast to the epigastrium and the navel, hence by the lymphatics of the round and falciform ligaments to the liver. From these channels along the round and falciform ligaments cancer cells may bud off and become free in the peritoneal cavity and may lead to distant metastases in the intestine or in the ovary, the cancer cells being carried thither by the movements of the stomach and intestines or by gravity. The lymphatics of the diaphragm may be reached along the epigastric route and thus the rare implication of the retro-peritoneal lymph-glands and of the kidney is explained. Thus in long-standing cases of breast cancer these distant metastases are brought about, according to Handley, by continuous invasion along lymphatic channels.

There is some confusion regarding the significance of palpable glands in the axilla in a case of breast tumor. We regard it as one of several local signs suggestive of carcinoma and yet induration and enlargement of axillary glands are by no means pathognomonic of malignancy. Ewing would have us believe that the lymph-nodes undergo a process of change antecedent to the actual development of secondary metastasis, he states that for months or weeks the soil is prepared in lymph-nodes draining a primary focus of carcinoma. He describes the more recent changes as consisting of moderate swelling of the gland, diffuse hyperplasia, catarrhal exfoliation of sinus endothelium, multiplication of follicles, not uncommonly at a later period the nodes become atrophic and fibrous and may become extensively invaded by fat. The more recent changes he attributes to the absorption of toxic products from the tumor, autolytic and bacterial. This conception is not wholly in consistence with clinical observation. The changes in a lymph-gland antecedent to the production of a secondary cancer growth are more likely to be synchronously developed with and dependent upon changes in the breast

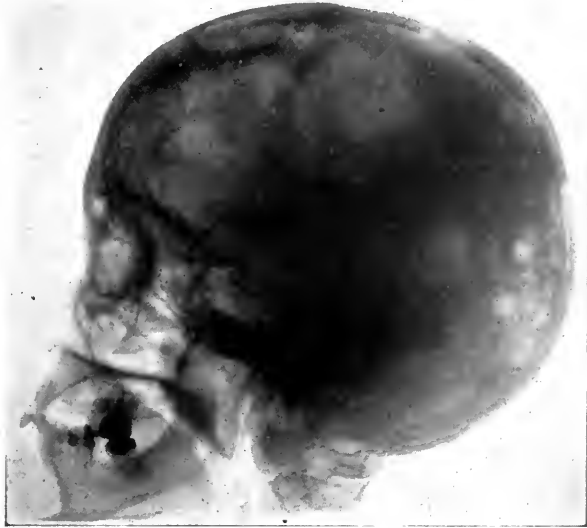


FIG. 1.—Woman sixty-three years of age, suffering from breast cancer metastases in cranial diploë three and a half years after radical operation on the breast.

which are antecedent to the development of a carcinoma in the breast. We frequently find such inflammatory hyperplasia in the glands in cases of chronic mastitis and we believe such cases often develop cancer both primary and secondary. The following case illustrates my point: A woman aged thirty-three had a nodular diffuse involvement of both breasts with enlarged palpable glands in each axilla. Both breasts were removed with the axillary contents. The right breast gave a typical histological picture of medullary cancer with metastases in the axillary glands: the left breast was the seat of chronic mastitis, the glands showing inflammatory changes, but neither in the breast nor in the glands was there any evidence of malignancy.

The palpable axillary gland may, in some instances, give us the chief evidence of the true nature of the case. In a woman of forty-nine a radical operation was performed on a clinical diagnosis of breast cancer. The pathologist reported chronic mastitis without malignancy. Through an accidental circumstance the axillary glands were lost sight of and were not examined for some days subsequently: undoubted cancer was found in the glands; the breast was again carefully searched and eventually a small focus of malignancy was found, surrounded by a large area of chronic inflammatory change. Among other things this illustrates the futility of trusting to a quick section in such a case.

On the other hand, carcinoma of the breast may in rare instances be responsible for distant metastases while the local lymph-glands escape. A woman of thirty-nine years of age came to me with a metastatic growth in the spine. This woman had had the right breast removed three years previously for a tumor which histologically was considered cancer. The axillary lymph-glands had never been disturbed and never showed any signs of involvement. It is possible the late changes in the lymph-glands, described by Ewing and quoted above, may be responsible in some instances for failure of the metastatic processes to develop in the lymph-gland. The atrophic, fibrous and fatty changes in a gland may so interfere with its function as a filter that the cancer cells fail to take lodgment in the gland. These atrophic changes in the gland may have occurred as the result of inflammatory processes in the breast prior to the development of the primary cancer growth.

Clinically, when a diagnosis of a primary carcinoma has been made we must always assume the involvement of lymph-glands even if there is no gross manifestation of the fact; our modern clinical operation for breast cancer is devised to meet such an hypothesis.

If the primary growth is extensive and advanced the lymph-nodes rarely, if ever, escape, and these are noticeable in the gross. In fact, the absence of the gross involvement of lymph-glands at operation in a case exhibiting evidence of advanced and extensive malignant disease should lead us to doubt the accuracy of our diagnosis. The following occurring in my series of stomach cases may be cited in illustration:

Mr. H., aged fifty, a farmer, had suffered for nearly a year from digestive disturbance. He had lost weight. The analysis of stomach

contents showed the presence of lactic acid and of the Opler-Boas bacillus; there was an absence of free hydrochloric acid. Examination by the X-ray after a barium meal demonstrated a large tumor, occupying the body and fundus of the stomach with a huge filling defect, showing a very narrow channel four or five inches long through the growth. The case seemed inoperable, but at the patient's earnest solicitation I opened the abdomen and found a large mass occupying the fundus of the stomach and the cardiac portion of the body. I considered it advanced malignant disease, but I noted in my clinical records the fact that there were no enlarged glands to be found and no evidence of secondary deposits elsewhere. The abdomen was closed and the condition of the patient considered hopeless. Two years and a half subsequently I received a letter from a doctor in the West informing me that my patient was enjoying excellent health; he had put on weight and was in charge of a large stock of cattle and suffered no gastric disturbance whatever; he was applying for life insurance.

The record is significant because, while the conditions present simulated extensive malignant disease, the entire absence of metastatic development should have been sufficient to arouse our suspicions and to suggest the true diagnosis of inflammatory growth.

A passing reference may be made to the significance of the involvement of the supraclavicular lymph-glands in malignant disease of the abdominal viscera. The condition is most frequently observed in cases of cancer of the body of the stomach with secondary deposit in the lymphatic glands at the root of the neck on the left side. The explanation formerly suggested was that the lymphatic channels along the œsophagus conveyed the cancer cells from the stomach to the glands which were invaded in the neck. Later, it became evident that other abdominal organs, when the seat of cancer, showed metastases in the supraclavicular glands. This was notably the case in the uterus, the adrenals, the testis and the prostate. The correct explanation of these phenomena is that the thoracic duct is the channel of invasion and that, by a retrograde course from the thoracic duct at the root of the neck, we have implication of the lymph-glands in metastatic growth. Troisier first drew attention to these facts in 1886. The glands in the right supraclavicular region have been involved in some cases. I have several cases in my series showing this phenomenon in gastric cancer.

*Abscess Formation and Gland Metastasis.*—Abscess formation in connection with the secondary manifestations of malignant disease is not uncommon; the pyogenic organisms find entrance from an ulcerating surface and such infections are usually found in connection with carcinoma affecting the mucous surfaces. In three cases recently one had to deal with abscess complicating cancer of the colon. This is not an uncommon finding. In one of these an abscess which had developed in connection with a cancer of the descending colon, penetrated the psoas fascia and, behaving like the psoas abscess of spinal caries, had induced the patient to lie with the hip-joint flexed while a mass was found in the ileo-lumbar region.

An abscess developing in connection with glandular metastasis in cancer may be the first clinical evidence of disease, and the serious nature of the case may be completely masked by it. A woman fifty years of age had enlarged cervical glands for four weeks with pain and stiffness. The temperature rose to  $104^{\circ}$  and the tissues of the neck showed marked oedema. An incision was made and a retropharyngeal abscess was opened and drained.



FIG. 2.—Woman sixty-three years of age, suffering from breast cancer metastases in ribs, humerus and bones of shoulder girdle three years and a half after radical operation on the breast.

in the neck had attained enormous size, while the primary focus was still comparatively insignificant.

*Primary Carcinoma of the Appendix, Etc.*—The absence of secondary metastases in so-called *primary carcinoma of the appendix* is surely significant. I have elsewhere called attention to the remarkable fact that in a large percentage of the cases reported in the literature there is a history of tuberculosis and I have placed on record the history of two cases occurring in sisters, both of whom were tuberculous. One had pulmonary phthisis and in the other the appendix, which was the seat of carcinoma, was attached to a tuberculous Fallopian tube. In my paper I referred to a case of tuberculous Fallopian tube reported by Balfour and Watson; they found definite evidence

A week subsequently a similar abscess was opened on the opposite side of the neck. Four months later a mass of dense scar tissue was dissected out from the deep tissues of the neck and histologically one was surprised to find epithelial cell nests embedded in fibrous tissue. After careful search one failed to find the primary focus of malignancy. Later, it was found she had a small malignant ulcer in the larynx below the vocal cords on the posterior portion of the cricoid cartilage. This subsequently penetrated into the pharynx, dyspnoea developed, and the patient eventually died of septic pneumonia.

Before death the tumors

of tubercle in one portion of the tube and in another portion the authors show a histological picture indistinguishable from carcinoma. From a study of these cases one is justified in concluding that primary carcinoma of the appendix is in some way connected with the development of tuberculosis, and in fact may be wholly a manifestation of that pathological process.

In cancer of the rectum and rectosigmoid it is not unusual to find secondary metastases in the lymph-glands and in the liver. This fact prompts one to enter a protest against the performance of a radical operation for the removal of a cancer of the rectum or even the performance of a colostomy without first opening the abdomen in the middle line for the purpose of estimating with accuracy the extent of the primary disease and the presence or absence of metastases within the abdomen.

One of the vagaries of secondary tumors is found in patients in whom a single lymph-gland becomes the seat of a metastatic growth without any tendency for the involvement of other nodes in the neighborhood. Thus in a man of forty-nine a carcinoma of the naso-pharynx was removed. Two years subsequently I removed a single gland, in bulk the size of a large walnut, from the neck, situated under the

sterno-mastoid muscle just below the level of the angle of the jaw. This was undoubtedly malignant, showing many mitotic figures under the microscope, but the character of the cell structure was such that we consider it a malignant endothelioma. The man died three years and ten months afterwards with recurrence of the primary growth in the naso-pharynx, extending into the base of the skull and causing pressure symptoms at the base of the brain. There never was the slightest recurrence in the neck, although the patient lived nearly four years after the removal of the solitary gland.

The relationship between Hodgkin's disease and lymphosarcoma is very



FIG. 3.—Woman sixty-three years of age, suffering from breast cancer metastases in both femora and in bones of pelvic girdle three years and a half after radical operation on the breast.

intimate. In the acute manifestations of Hodgkin's disease the histological picture of a gland removed for diagnostic purposes is one of a malignant lymphosarcoma. Moreover, we sometimes find these metastasizing. I have in my records a case of lymphosarcoma of the axilla with metastases in the thyroid gland; a similar case is recorded by Osler.

*Implantation Carcinoma.*—Implantation of carcinoma upon serous surfaces occurs with great frequency, especially within the serous sac of the peritoneum. An instructive case was in a man sixty-three years of age, in a low state of nutrition and suffering from a cancer of the pylorus. At operation one found the growth was freely movable; there were no metastatic manifestations. I performed gastro-enterostomy and determined to postpone pylorotomy until a later period on account of the miserable condition of the patient. The patient's condition improved but he had a cough, and the second part of the operation was, on that account, postponed, so that it was not undertaken until an interval of three weeks and a day had elapsed. On opening the abdomen the second time one found the pyloric growth had penetrated the serosa and secondary deposits had occurred by implantation in the adjacent omentum and in the liver. The patient died two and a half months subsequently. The record of such a case is an argument against the two-stage operation for similar conditions. We believe, if the condition of the patient warrants it, the entire surgical procedure should be undertaken in one stage.

The following case suggests the implantation of cancer by the auto-inoculation of ascitic fluid in a woman who suffered from general abdominal carcinomatosis.

This woman was fifty-one years of age and her clinical history extended over a period of three years. The trouble began in the pelvis, probably a malignant tumor of the ovary. Towards the latter part of her illness she suffered much distress from the accumulation of large quantities of ascitic fluid requiring frequent aspiration. About this time Hodenpyl (1910) had suggested the value of ascitic fluid in certain cancerous patients in the control of the course of cancer in other individuals. I was tempted to try the effect of submammary injection of the fluid in this patient upon herself. Some twelve to fifteen injections were made. I failed to obtain any beneficial result, but a tumor appeared in her right breast with enlargement of the axillary glands. This was apparently an implantation carcinoma. She died six months subsequently.

General abdominal carcinomatosis is all too familiar and does not require detailed description in this paper. The condition is apparently of the type of an implantation carcinoma and frequently, though by no means solely, has its origin in a malignant papilloma of the ovary, which has broken through the serous covering and has become disseminated throughout the peritoneal cavity. The omentum is invariably involved in these cases, but there appears to be no limit in the degree of dissemination, so that in many instances no organ within the abdomen, possessing a serous covering, escapes.

Nodules of various sizes are found in all directions, and there is, as a rule, a large accumulation of ascitic fluid.

It is a remarkable circumstance that many of these patients live for long periods after extensive dissemination has occurred. There is apparently a high degree of resistance established. Their nutrition is maintained in spite of extensive disease. It was this circumstance which led Hodenpyl to believe that he could raise the resistance of patients suffering from cancer by inoculating them with ascitic fluid removed from a patient suffering from general abdominal carcinomatosis. The results unfortunately were disappointing. I have the record of one patient who lived four years and five months after she was found to have inoperable cancer in the pelvis. Large quantities of fluid were drawn off from time to time. Towards the latter part of her illness she had one grain of morphia every two hours. Another of my patients, fifty-three years of age, who lived for four years after the development of extensive metastases, also took large doses of morphia, taking as much as five grains hypodermically in one dose towards the latter part of her life. One is inclined to suggest that possibly morphia has some influence in maintaining nutrition and prolonging life in these cases.

The implantation and dissemination of cancer during our operative procedure is a danger which must be guarded against in our operative technic. This danger exists, for example, in our operations for breast cancer. It is a very real danger in the manipulation of the cancerous breast prior to operation or in the method of scrubbing and preparing the parts to secure an aseptic field. There is a strong argument here also against the employment of the "quick section" for diagnostic purposes at the time of operation. The writer has long held these views and has insisted upon the greatest gentleness in manipulating a cancerous breast both before and during operation. Dr. Leila Charlton Knox has recently published a paper on "The Relationship of Massage to Metastasis in Malignant Tumors." She carried out numerous experiments in mice; for example, in one series the animals were inoculated subcu-



FIG. 4.—Woman fifty-three years of age, suffering from adenocarcinoma of the uterus; metastases in tibia causing complete destruction of three inches of the entire thickness of the shaft of the bone.

taneously in the inguinal or axillary region with mouse carcinoma, the resulting tumor when it reached the size of 5 mm. in diameter was vigorously massaged for one minute on two consecutive days, the tumors were then excised and the animals killed twenty-seven days later; in a large percentage of the cases metastases were found in the lungs. In another series of experiments very gentle massage, carried out every day for a fortnight, with similar findings. Experiments of this nature are instructive and suggestive, the results obtained are quite in harmony with our knowledge of the dissemination of cancer in man.

*Dissemination Through the Blood Stream.*—The dissemination of malignant tumors may occur through the blood stream. This is characteristic of sarcoma, while carcinomata, on the other hand, are mainly spread through the lymphatic vessels. This is probably due to the fact that the sarcomata are more closely associated with the blood-vessels both in their intimate histological structure and in their immediate surroundings than the carcinomata. We are all familiar with the tragic rapidity with which malignant sarcomas of bone metastasize in the lungs; so constantly does this occur we are compelled to take the most gloomy view in prognosis and are almost forced to conclude that removal of the limb at a point far above the primary growth is of no avail. Spontaneous fracture at the seat of growth would tend to hasten the process. In my series I have several other types of sarcoma showing metastasis in the lungs. Thus in a man of forty-two years of age, whose limb was amputated for a sarcoma developing in the muscles of the calf of the leg. Secondary growth appeared in the lungs six months subsequently. The sarcoma which occurs in the kidney in young children shows a similar fatal tendency to metastasize in the lungs.

Many tumors, both simple and malignant, invade the blood-vessels by direct continuity of growth. Of the former certain enchondromata are characteristic examples. The tumor first described by Gratzwitz, the hypernephroma, has excited much interest in the study of its etiology; it is of interest further in the remarkable tendency to metastasize widely. Bone metastasis is not uncommon, and I have recently had the opportunity of examining a secondary hypernephroma in the brain. Chorionepithelioma is so intimately connected with the uterine blood sinuses we are not surprised to find how widely and persistently it leads to metastatic growths through the blood stream.

*Bone Metastasis.*—One of the most interesting phenomena in the course of malignant disease is the occurrence of metastases in bone. The bone may be invaded by direct spread from the primary growth. In breast cancer, for example, we may have involvement of the ribs and sternum. According to Sampson Handley more distant bones may be reached (humerus, spine, etc.) by direct extension through lymphatic channels; one of his arguments in this connection is the immunity of the bones below the elbow and below the knee, such cases being too distant for lymphatic connection. On the other hand, he traces lymphatics to the deltoid insertion of the humerus, and to the trochanter of the femur as the most likely points of entrance for these bones.



Schmorl, on the other hand, considers the pathway to be by the blood stream.

Bone metastasis in cancer is much more common than was hitherto believed. Von Recklinghausen made a careful study of cancer growth in bone in 1891. Sir Henry Thompson, as early as 1854, reported a case of carcinoma of the prostate with metastasis in the spine. Schmorl of Dresden, was one of the first to remark upon the very great frequency of its occurrence. According to this authority the metastatic growth may only be discovered by microscopic examination, but in the vast majority of cases it is distinguishable in the gross. Schmorl finds that of all cases of cancer coming to autopsy no less than thirty-four per cent. show metastases in bone. In late years the X-ray has proved of great value in determining the diagnosis, and has demonstrated the frequency of its occurrence.

I have a number of cases in my series of which I may cite a few examples. There were two cases of mammary cancer in which metastases occurred in the cranial diploë. A comparatively common locality was the cancellous bone of the body of the vertebra. Others were in the bones of the extremities.

A somewhat remarkable case was in a woman of fifty-three years of age, who had an enlargement of the right tibia for seven months, when she tripped on a mat and probably fractured the bone at that time, as she was unable to put her weight upon the limb subsequently. Nine months afterwards her medical adviser incised the "swelling," from which came blood and serum. It was then assiduously poulticed with linseed. This woman first came under my care twenty-one months after the first appearance of trouble in the leg. One found a fusiform tumor and the X-ray picture showed complete destruction of three inches of the entire thickness of the shaft in the middle third of the tibia (Fig. 4); amputation was performed at the knee-joint; histologically the growth proved to be carcinoma. A careful search was made for a primary growth—breast, abdomen, pelvis, etc.,—but without success, and the patient left hospital and we lost sight of her. Eight months subsequently she returned to hospital when we discovered an adenocarcinoma of the uterus with extension to the bladder. The condition was inoperable. She was treated by X-ray but, although there was definite recession of the disease for a time, she died two years subsequently.

This patient therefore had the remarkable history of a secondary carcinoma of the tibia which existed two years and five months before the primary cancer of the uterus was discovered. Furthermore, she lived for four years and five months after the first appearance of the disease.

As an example of metastasis in the spine, I might mention the following case with a somewhat unusual history:

A woman of thirty-nine had her right breast removed three years before she came under my observation. The nature of the trouble in the breast at that time was somewhat doubtful; it was supposed to be "chronic mastitis," but the report of the pathologist suggested probable malignancy. The axillary glands were not removed. A year and a half subsequently she complained of abdominal pain and pain in her back.

As the result of the findings in an X-ray series after a barium meal her appendix was removed. She insisted, however, that her "back was broken," and in truth she was right. Three years after the removal of the breast a stereoscopic picture obtained by the X-ray showed an almost complete destruction of the body of the fourth lumbar vertebra, with less extensive involvement of the twelfth dorsal, the fifth lumbar and the upper part of the sacrum. It was a purely destructive process with no new bone formation and without any invasion of the intervertebral discs which remained intact.

This patient therefore showed metastasis in the spine three years after the removal of a breast carcinoma and the remarkable fact remains that the axillary lymph-nodes were never involved and were not removed.

One of my patients exhibited multiple bone metastases at widely separated parts of the skeleton.

A woman, sixty-three years of age, was operated upon for cancer of the breast with two subsequent operations, during the next three years, for recurrence in the axillary glands. Three years and a half after the first operation she was treated by an osteopath for "rheumatism" of the right hip. She had lost weight. Shortly after this she came to hospital, when we discovered metastases in the upper part of each femur, the ribs, the humerus, and in the cranial diploë (Figs. 1, 2, and 3). This woman is still living, five and a half years after the breast was amputated and two years since the multiple secondary growths in the bone were discovered. She now has a large mass of recurrent growth in the axillary glands.

The course of events in the bone at the seat of a secondary carcinoma are of interest. Bone is destroyed at the seat of the growth and spontaneous fracture of a long bone may occur. In this event, under suitable conditions of rest and splinting, callus may be formed and union may occur. In other instances destruction of the entire thickness of a bone may involve a considerable portion of a shaft and union becomes impossible. The tumors are frequently multiple. A study of these cases would lead one to assume that in many cases a secondary growth of cancer in bone remains more or less dormant for long periods of time. The tumors do not, as a rule, grow to great size; they are confined within the bone and do not tend to invade the soft structures beyond. In time, however, the surrounding tissues may be infiltrated and increased rapidity of growth ensues.

Metastatic tumors in bone may be present without being suspected by either the patient or her medical attendant; in many instances their existence has only been discovered accidentally. The complaint of pain in various parts of the skeleton, particularly in the spine in patients suffering from cancer, arouses suspicion, and an investigation by the X-ray should be undertaken. Treatment of these cases by the radiologist may possibly be of some service. It is impossible to make any definite statement in this regard, but certain cases would appear to be relieved of pain and to improve in general health under this treatment.

## THE SECONDARY MANIFESTATIONS OF MALIGNANT DISEASE

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## RECURRENCE VERSUS METASTASIS IN CARCINOMA\*

BY ELLSWORTH ELIOT, JR., M.D.  
OF NEW YORK, N. Y.

THE term "recurrence," after the excision of a carcinoma, is ordinarily used to indicate its return or reappearance resulting from the gradual growth of a focus of tumor tissue, which, owing to its minute size, escaped detection, and therefore removal, at the time of operation. In this paper the writer has been obliged to select the same term to indicate the independent development of a second carcinoma without any etiological relation whatever to the original growth which, presumably, was completely and successfully removed. The term recurrence, used in the latter sense, therefore, implies a fresh outbreak of the lesion at a time so distant and in an organ so remote from that originally involved that no distinct etiological relationship can be traced. Recurrences of this type, however, do not constitute the sole evidence which may be cited in favor of the independent development of two carcinomatous foci. Of equal importance at least is, first, the evidence supplied by cases of the simultaneous or nearly simultaneous development of carcinoma in different parts of the same organ or in entirely separate organs; secondly, instances of isolated recurrence in a distant organ without discoverable metastasis in any other part of the body, in which cures are effected by a secondary operation.

While strong clinical evidence can be cited in an endeavor to establish the fact that carcinomatous growths may thus develop simultaneously or consecutively and yet independently, that they are not unusual or rare manifestations of a common malignant process can not actually be proved, especially in view of the complete mystery in which the actual cause of carcinoma is at present invested. At least the clinical features of the cases herewith briefly reported differ widely from the corresponding features of carcinomatous metastasis, either through the lymphatic system in which metastasis ordinarily follows a standardized course, or through the much less frequent blood current in which the location of metastases, for obvious reasons, may vary widely.

Clinical evidence pointing to the possibility of the independent development of multiple carcinomatous foci is presented by a study of carcinoma of the breast. The following instance illustrates the development of two carcinomatous foci of about the same size and presenting identical physical signs, yet separated by a considerable interval of normal glandular tissue.

CASE I.—Female, thirty-nine. An aunt had "tumor of the breast." Six weeks before its removal a growth about the size of a small hen's egg was found in the lower outer quadrant and a similar, though

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\* Read before The American Surgical Association, Washington, D. C., May, 1922.

somewhat smaller growth, that had not been noticed by the patient, was found in the upper inner quadrant of the left breast. The right breast was normal. Examination of the left breast and axilla, after operation, showed typical carcinoma of both nodules without axillary involvement. Two months after operation the patient died of some unknown acute infectious disease, after a short illness.

Instances of the simultaneous development of carcinoma in both breasts have been observed, although no case of this character has been treated by the writer. It is a rare condition.

Instances in which after radical removal of a carcinoma of the breast, carcinoma appears in the opposite breast without discoverable metastasis in any other part of the body. The following instance illustrates this type of mammary carcinoma.

CASE II.—Female, fifty-four. Removal of a small carcinoma of about six months' standing and without axillary involvement. No lump was found in the opposite breast until eighteen months after the primary operation. A similar growth then appeared, also without axillary involvement, and was removed in the same thorough way. Twelve years after the second operation the patient, free from recurrence, was in excellent health.

This case is worthy of comment in that, were the carcinoma of the remaining breast the result of lymphatic extension, it is scarcely conceivable that the intervening glands, either without or within the chest cavity, would have remained free from carcinomatous invasion. As a matter of fact, such "intervening involvement" is usually observed in cases in which carcinoma in the remaining breast is a part of an inoperable metastasis. Theoretically the condition, herewith reported, could be accounted for by the development of a vascular metastasis, a highly improbable explanation. To regard this case, therefore, as an example of the independent development of carcinoma in widely separated organs, seems reasonable.

The following case illustrates the development at or about the same time of carcinoma in widely separated parts of the body.

CASE III.—In May, 1919, a carcinoma of the breast of uncertain duration but with such extensive axillary involvement as to render recurrence almost inevitable, was removed in a patient of forty-five. Twenty-five months later, after a history of increasing constipation for the previous six months, an enterostomy was performed for what proved to be an inoperable carcinoma of the sigmoid, the patient surviving the operation for ten months.

Which growth in this case was primary must remain uncertain. The far advanced condition of the carcinoma of the sigmoid, however, indicated a duration of at least several years and seemed to render possible a simultaneous independent development of both carcinomata. At least carcinoma

of the large intestine as a metastatic manifestation of carcinoma of the breast or vice versa is rarely observed.

A further study of carcinoma of the large intestine provides certain evidence of the multiplicity or independent development of the lesion. The writer recalls a specimen of a carcinoma of the rectum shown by Professor Hochenegg in Wien to the members of the Clinical Surgical Society in 1912, in which there were two distinct foci, separated by at least three inches of normal mucous membrane. In this instance the lower growth might have been the result of contamination from the discharge of the upper, except for the fact that by reason of its size and the extent of the involvement of the rectal wall, the lower growth was the older of the two.

CASE IV.—In 1917 resection of a considerable portion of the sigmoid for an adenocarcinoma involving the entire thickness of the visceral wall with beginning lymphatic involvement in the adjacent mesentery. End-to-end anastomosis. Nearly three and one-half years later resection of the splenic flexure for the relief of an attack of sub-acute obstruction the result of an adenocarcinoma at that point. Owing to the enormous dilatation of the cæcum, which completely filled the pelvis, no anastomosis could be done and the patient, one and one-half years later, is free from recurrence with an artificial anus. Examination of the resected sigmoid at the time of the second operation showed the anastomosis to be in excellent condition.

The lesion in this instance is somewhat analogous to the lesion described in Case II in which the second breast was removed for carcinoma eighteen months after a similar operation on the opposite side, with the difference that sufficient time has not elapsed to determine whether the patient will remain free from further recurrence. Moreover, the involvement of the splenic flexure after the sigmoid eliminates the possibility of dependence of the former growth upon some form of irritation of the primary lesion, excepting, of course, possible contamination from reversed peristalsis.

CASE V.—Seventeen years after excision of a carcinoma of the breast without axillary involvement, examination after an attack of alleged hemorrhoids revealed a carcinoma of the sphincteric portion of the rectum. This was removed by the usual form of Kraske's operation. The patient, over seventy, died several years later from natural causes without sign of recurrence.

This case illustrates the development of a secondary carcinoma, which, both in view of the remoteness of its location as well as in the unusually long period elapsing since the removal of the original growth, probably had no distinct etiological relationship with the primary lesion.

CASE VI.—Twenty-two years after the radical removal of a carcinoma of the left breast without axillary involvement, inoperable multiple carcinomata developed in the abdomen, the liver especially being

involved. Patient died within six months, without any indication of thoracic involvement. Unfortunately no autopsy could be obtained.

This case is of interest, irrespective of all speculation as to the possibility of a fresh outbreak of the lesion in the abdominal cavity in emphasizing the fact that no interval of years elapsing after an operation for carcinoma without visible recurrence, can be adopted as a standard of positive cure. At first three years was considered a sufficient interval for such a standard, then five years. This, however, is much too short, and no patient should be discharged from observation no matter how many years may have elapsed since the original operation.

Careful consideration of the clinical features of the cases herewith reported fails to disclose any positive etiological relationship between the primary growth and those that developed secondarily. That carcinoma shares with many varieties of benign tumors the clinical manifestation of independent multiplicity cannot be advanced. There is no reason, however, why more than one glandular organ should not be exposed to the exciting cause of carcinoma, whatever that may be, either at about the same time or many years after the successful removal of the initial growth. This is certainly true of persistent and long-continued mechanical or other form of irritation which is recognized as the most important predisposing etiological factor in this justly dreaded lesion.

If, for the sake of argument, the possibility of the independent development of two or more carcinomatous foci is granted, the wisdom of the thorough excision of each focus cannot be gainsaid. While metastasis ordinarily contra-indicates surgical interference, analysis of the majority of cases herewith cited leads to the conclusion that a wide excision of carcinomatous foci without evident interdependence yields encouraging results, and the propriety of adopting such a surgical principle will, I believe, be concurred in by all.

## THE TREATMENT OF CANCER OF THE JAWS\*

OBSERVATIONS CONTINUED SINCE 1918, COVERING 26 ADDITIONAL CASES

BY ALBERT J. OCHSNER, M.D.

OF CHICAGO

At the meeting of this society four years ago, I reported my clinical observations concerning malignant tumors of the jaws operated since 1901 at the Augustana Hospital. One hundred cases in all.

Since that time I have added twenty-six cases to my series, in all of which the tumor has been removed by means of the actual cautery, and in addition to this treatment, all of the cases have been treated intensively with X-ray.

A number of these cases were so far advanced that I should not have undertaken operative treatment except for the fact that since the administration of massive doses of X-ray through thick fillers, a few apparently absolutely hopeless cases of cancer in various parts of the body have made remarkable recoveries. In the meantime, however, I have been consulted by a considerable number of cases that were absolutely beyond hope. These were not operated upon but referred for palliative treatment to the X-ray department, and these are not included in this series. All of these absolutely inoperable cases had been previously operated elsewhere.

Twenty of these patients operated since the last report was made ranged from fifty-one to seventy-five years of age. Six were less than fifty years old.

The youngest patient three years old, and the next nine, suffered from spindle-celled sarcoma of the upper jaw.

The third and fourth, each twenty-one years of age, suffered from epulis of the upper jaw.

The fifth, twenty-eight years of age, suffered from carcinoma of the lower jaw, involving also the parotid gland.

The sixth case, forty-four years old, suffered from sarcoma of the upper jaw, involving the antrum.

There were four deaths in this series of twenty-six cases. Two, fifty-seven and sixty-three years old, respectively, suffered from carcinoma of the lower jaw, involving the lymphatics of the neck. In these an extensive dissection of the neck was made with the cautery, extending from the jaw down to the clavicle. Death occurred on the sixth and seventh days, respectively, from hemorrhage. In one the common carotid artery had been ligated during the operation.

A third case, a man sixty-six years of age, suffering from a carcinoma of the upper jaw, involving the antrum, died on the eighth day after the operation from hemorrhage.

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\* Read before the American Surgical Association, May 1, 1922.



# TREATMENT OF CANCER OF THE JAWS

## TABLES

TABLE I.—PATHOLOGY

	Cases	Per cent.
Carcinoma .....	83	65.9
Epulis .....	20	15.8
Sarcoma .....	21	16.3
Leucoplakia .....	1	.8
Odontoblastoma .....	1	.8

TABLE II.—LOCATION

	Carcinoma		Sarcoma	
	Cases	Per cent.	Cases	Per cent.
Inferior maxilla .....	57	45.2	6	4.8
Superior maxilla .....	31	24.6	8	6.3
Maxillary sinus .....	7	5.5	2	1.6
Cheek .....	6	4.8	1	.8
Parotid gland .....	3	2.4	3	2.2
Palate .....	1	.8	1	.8

TABLE III.—SEX

	Carcinoma		Sarcoma		All cases	
	Cases	Per cent.	Cases	Per cent.	Cases	Per cent.
Male .....	71	56.4	18	14.4	89	70.6
Female .....	18	14.4	19	15.1	37	29.4

TABLE IV.—DURATION OF SYMPTOMS BEFORE TREATMENT

	Cases	Per cent.
1 to 3 months .....	29	23.1
3 to 6 months .....	29	23.1
6 to 12 months .....	29	23.1
1 to 2 years .....	37	29.4
2 to 5 years .....	2	1.6
	126	

TABLE V.—OPERATIVE DEATHS

	Cases	Per cent.
First day .....	3	2.4
2 to 5 days .....	5	4.0
5 to 20 days .....	8	6.3
20 to 40 days .....	3	2.4
After 40 days .....	5	4.0
Total deaths .....	24	19.1

## ALBERT J. OCHSNER

TABLE VI.

Case No.	Age	Sex	Occupation	Location	Etiology	Duration	Lymph Glands Involved	Previous Treatment
67804	77	F.	.....	Lower lip and jaw	Unknown	3 mos.	Yes	None
64820	65	M.	Egg inspect.	Cheek and lower jaw	Smoker canker sore	1½ yrs.	Yes	None
54355	56	M.	Machinist	Lower jaw	Tobac. chewer. Pyorrhoea	8 mos.	No	None
59892	70	M.	.....	Parotid gland. Lower jaw	Tooth irritation	5 yrs.	No	9 operations
61198	60	M.	Farmer	Upper max.	Carious teeth. Bit cheek	6 weeks	No	Teeth extract.
68691	52	F.	Dentist	Left antrum	Unknown	5 mos.	No	Caut.-Rad.-X-ray
59294	28	F.	Housewife	Parotid gland. and lower jaw	Erysipelas of cheek	13 mos.	Yes	2 knife ops.
57253	52	M.	Miner	Lower jaw	Epith. lip; recurrent	7 yrs.	Yes	V-shaped incis. lip.
66911	68	F.	Housewife	Lower jaw and cheek	Carious teeth	1 yr.	Yes	2 previous ops. X-ray and radium
62771	53	M.	Carpenter	Lower jaw and face	Cold sore on lip	16 yrs.	No	Resect. upper jaw
68268	54	M.	.....	Lower jaw and lip	Epith. lower lip	9 mos.	Yes	V-shaped incis. X-ray and radium 9 mos. ago
68506	66	M.	Clerk	Carci. upper jaw and antrum	Carious teeth	6 mos.	No	Incis. abscess
65335	21	F.	Housework	Lower jaw	After teeth removed	3½ yrs.	No	Teeth removed
65937	44	F.	Housework	Antrum	Unknown	6 mos.	No	None
61608	21	F.	Teacher	Upper jaw	Unknown	2 yrs.	No	None
55328	62	M.	Farmer	Lower jaw	Not known	3 mos.	No	Cautery
66275	62	M.	Farmer	Upper jaw	Pyorrhoeal. Extr. teeth	1 yr. 2 mos.	No	None
61307	53	F.	Housework	Upper jaw and nose	Epith. nasal angle	8 yrs.	Yes	X-ray and paste
68612	9	M.	Schoolboy	Lower jaw	Tooth extr. July, 1921	7 mos.	No	Teeth extr.
57204	75	F.	Housework	Lower jaw	Teeth extr. June, 1918	6 mos.	Yes	X-rays
63661	3	M.	.....	Upper jaw	Not known	4 weeks	No	None
66697	64	M.	Farmer	Lower jaw and parotid	Not known	1 yr.	No	Cautery
57842	67	M.	.....	Upper jaw and parotid	Not known	8 mos.	No?	Cautery
61091	51	M.	Laborer	Upper jaw and cheek	Not known	5 yrs.	No	None
59325	57	M.	Salesman	Lower jaw	Pyorrh. and infect. teeth	12 yrs.	Yes	X-ray and extract. teeth
67031	63	M.	Carpenter	Lower jaw	Infected teeth. Chews tobacco	2 yrs.	No	None

# TREATMENT OF CANCER OF THE JAWS

TABLE VI.

Treatment	Date Op.	Date Re-op.	Result	Cause of Death	Time of Death after Operation	Diagnosis	Remarks
Cautery excision	8-26-21	.....	Recov.	.....	.....	Epithelioma of lower jaw	Started in lower lip
Cautery ex. Teeth ex.	11-17-20	.....	Recov.	.....	.....	Carcinoma lower jaw	Started in lower lip
Cautery irons	4-24-18	.....	Recov.	.....	.....	Carcinoma lower jaw	
Cautery irons	8-28-19	.....	Recur.	.....	.....	Carcinoma parotid and jaw	9 previous operations
Ex. rt. max. with caut.	12-27-19	.....	Recov.	.....	.....	Odontoblastoma max.	Started from biting cheek
Cautery irons	11-23-21	.....	Died	Cerebral embolus	2 days	Sarcoma	Recurrent case
Electric caut. and irons	7-9-19	.....	Recov.	.....	.....	Carcinoma parotid and jaw	
Electric caut. and irons	1-17-19	7-9-19	Recov.	.....	.....	Carcinoma lower jaw	Result of V-excis of lip
Electric caut. and irons	6-6-21	.....	Impr.	.....	.....	Carcinoma lower jaw	
Electric caut. and irons	5-17-20	.....	Rec.	.....	.....	Spindle-cell sarcoma	Recur. in lower jaw following sarcoma. Excision of upper jaw
Electric caut. and irons	10-8-21	.....	Impr.	.....	.....	Squam.—cell carc. of lower jaw	Result V-shaped excis.
Cautery incis. Sup. max.	11-3-21	.....	Died	Hemorrhage	8 days	Carcinoma antrum	
Cauterization and removal of teeth	1-10-21	.....	Rec.	.....	.....	Epulis	
Excis. max. with cautery irons	3-4-21	Recur. 6-24-21	Impr.	.....	.....	Sarcoma	Recurrence
Excision with cautery, ext. teeth	12-31-19	.....	Rec.	.....	.....	Epulis	
Cautery	7-25-18	.....	Rec.	.....	.....	Carcinoma	Recurrence
Cautery	4-7-21	X-ray 11-30-21	Rec.	.....	.....	Carcinoma	Several recurrences cauterized
Actual cautery, radium	2-4-20	.....	Impr.	.....	.....	Carcinoma	Stimulated by caustic paste
Actual caut. excis.	11-13-21	1-24-22	Rec.	.....	.....	Spindle cell sarcoma	3 mos. later all well. Plastic done
Actual caut. excis.	1-13-19	9-13-19	Recurrence	.....	.....	Carcinoma	Rapid recurrence
Actual caut. excis.	5-6-20	7-29-20	Recurrence	.....	.....	Epulis, upper	Became spindle-cell sarc. and recurrence
Actual caut. excis.	7-9-20	.....	Rec.	.....	.....	Carcinoma	Well after 2 yrs.
Actual caut. excis.	3-10-19	.....	Rec.	.....	.....	Epithelioma	
Actual caut. excis.	12-10-19	.....	Rec.	.....	.....	Leucoplokia	
Bloc dissect of neck cautery excis.	7-11-19	.....	Died	Hemorrhage	7 days	Epulis, malign	
Ligation common carotid artery.	12-27-18	.....	Died	Hemorrhage	6 days	Carcinoma	

A fourth patient, fifty-two years of age, with the same condition, died suddenly on the second day after the operation from cerebral embolus. All of these cases were so far advanced that there was very little hope of a permanent recovery, and in all of them the operation was very extensive and they all knew that they were taking a desperate chance, which they were all willing to take. Judging from their desperate condition, it seems that they made a wise choice.

This series contains nine females and seventeen males, or nearly twice as many males as females.

The upper jaw was involved eleven times, the lower fifteen times.

In four cases the tumor had developed from an epulis.

In four cases the tumor was a sarcoma.

In sixteen the tumor was a carcinoma.

In none of these cases could metastases be demonstrated at the time of operation in different parts of the body, which made it seem worth while to make an effort to destroy the entire growth in the jaw and in the cervical lymph-nodes with the cautery because it seemed that the thorough destruction of these areas would give the patient some chance of a permanent recovery.

So much progress has been made in the use of X-ray and radium that the next few years may develop marked changes in the treatment of these cases.

At the present time the destruction of these growths with the actual cautery, or with one of the methods of applying diathermy, seems to give better chances of a permanent cure than excision with the knife.

All of these cases were operated in the inverted Trendelenburg position with the head of the table raised to an angle of 45 degrees.

They were under very complete morphine, atropine, ether anæsthesia administered with the patient in the horizontal position, but no ether was administered after the operation was begun nor after the head of the table had been elevated.

The cerebral anæmia caused by the position seemed to suffice to carry the patient through the operation without the necessity of administering any further anæsthetic. There were no other pneumonias.

In these cases our observation in the previous series of cases has again been confirmed that cases that have a recurrence following an incomplete operation have but a very slight chance for a permanent recovery. This shows the importance of making a very thorough operation at the time when such tumors are first noticed.

We are collecting reports concerning deaths occurring since these patients left the hospital and the condition of those who are still alive, but belated reports are still coming in so this table will be added later.

Our observation has convinced us that early and very extensive operation with the cautery, followed by carefully planned after-treatment with X-ray or radium, is quite worth while in these cases and that occasionally even advanced cases will be permanently cured by this method.

The appended table gives details concerning this series of twenty-six cases.

## CARCINOMA OF THE THORACIC ŒSOPHAGUS

FINAL NOTES AND POST-MORTEM EXAMINATION IN THE CASE REPORTED  
IN THE ANNALS OF SURGERY, SEPTEMBER, 1921

By HOWARD LILIENTHAL, M.D.  
OF NEW YORK, N. Y.

AFTER the patient's discharge, apparently entirely well, early in May, 1921, there was gradual narrowing of the lumen of the mucocutaneous border of the upper segment. Although he was able to take solid food in a normal manner, he was kept under observation and bougies were passed frequently. Gradually narrowing appeared, but the patient's general condition was excellent and his weight almost or quite up to his normal.

On October 10, 1921, Doctor Yankauer performed œsophagoscopy and finding what looked like a little granulation tissue in the mucosa just above the junction with the skin, he removed a small polypoid mass and stretched the constriction with the mechanical dilator. The patient had entered the hospital for this procedure, but went home the following day. Two weeks later Doctor Yankauer again used the œsophagoscope, but this time he found, above the upper stricture, two tiny elevations, both of which were removed. One proved to be polypoid and the other, unfortunately, a minute carcinoma.

The patient entered the hospital on November 14 and I operated, using general anæsthesia. I dissected up the two skin flaps and exposed the underlying cicatricial tissue, so as to produce as nearly as possible the appearances at the time of the original operation. Without the advantage of landmarks, merely by sense of direction, the dissection was continued, and I came upon the pleura, but fortunately did not enter it. The lung could be seen moving beneath in a perfectly normal manner. I at once sutured the tissues over the exposed pleura and continuing into the depths, reached the reconstructed cutaneous œsophagus, which was easily recognized. To make sure, I punctured it with a hypodermic needle with a syringe attached and withdrew air on suction and then incised from above downward into this skin œsophagus. Its surface was pinkish-white and fine hairs were still to be seen upon it. The exposure was perfect. The lower opening had somewhat contracted, although it was sufficiently large for swallowing, but the upper opening had become reduced to the size of a fine probe, and Doctor Yankauer, who was present, doubted that he had ever entered it. I divided this stricture and stretched it to the size of my index finger. Close to the mucocutaneous border was a tiny mass which looked like a polypoid. I removed it for examination. Nothing else abnormal was seen. A stomach tube was now passed beyond the cardia through the lower opening and left there for feeding. On November 23, 1921, Dr. Burton J. Lee very kindly came to the hospital and placed 180 millicuries of radium filtered through one-half millimetre of silver and one millimetre of rubber just above the upper stricture and left it in place for three hours.

About two weeks later there was some reaction with substernal pain. Another application of radium (237 millicuries) was made about December 27, also for three hours. This was followed by severe reaction with aphonia due to left chord paresis. This aphonia at first seemed to improve, but later returned and was permanent.

On February 16, 1922, the œsophagoscope showed a few scattered suspicious areas extending for about one inch above the mucocutaneous junction, and

Doctor Yankauer later applied the electro-cautery very lightly to these points through the wound in the back, the patient going home the next day. A week later there was a sudden shock with dyspnoea and great and rapid deterioration. There was strangling on attempting to swallow even liquids. The regular feedings had been entirely through the wound in the back. On February 24 I examined the wound and saw what appeared to be the aperture into the upper segment, but on passing an instrument into it there was immediate cough and strangling, showing that it had apparently passed into a bronchus. Pneumonia finally developed, and the man died on April 26, a little more than one year and four months after his first operation.

A limited post-mortem examination was permitted and revealed a large necrotic fistula between the trachea and the œsophagus, about one inch above the upper mucocutaneous border. There was a mass of glands, not large, behind the œsophagus, about opposite the perforation. There was a single hard mass between the œsophagus and the aorta in the same region, infiltrating and binding the two structures together. The transplanted skin looked absolutely normal and the line between the mucosa and the skin was smooth, the one membrane passing into the other without a visible cicatricial break. The lungs showed pneumonia.

The general appearances of the necrosis and of the fistula suggested to my mind that the radium had been the cause of the perforation. On stating this at the meeting of the American Surgical Association in Washington at the 1922 meeting, Doctor Lee thought that the electro-cautery might have been a causative factor as well as the radium. I still believe, however, that it was a radium necrosis, and this was also the opinion of Dr. F. S. Mandlebaum, who made a microscopical examination of sections through the tissues about the fistula. Dr. James Ewing, who kindly examined the slides, writes under date of June 23, 1922, as follows:

"I have little doubt under the circumstances you relate that the lesion is mainly the result of radium necrosis. Especially the wide, diffuse, simple necrosis of tissues without much reaction seems to indicate a radium effect."

*Epicritical Note:* This case and others in which the first stage only was performed have taught me: First, that the operation as planned is feasible. Second, that in order to succeed the patient must present himself while the disease is still localized within the œsophagus. Third, that much wider resection of the œsophagus should be made than would appear necessary judging by the extent of the visible lesion.

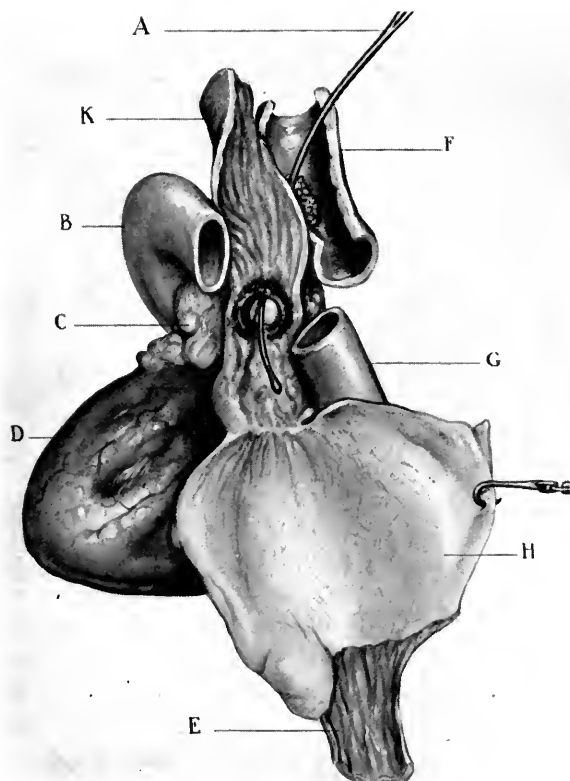


FIG. 1.—Post-mortem specimen. Posterior view. Note the sharp line of demarcation between skin and mucous membrane of œsophagus both above and below. There was a tendency to contract in the upper end (see wrinkles denoting puckering); no such tendency below. A, probe passing through fistula between trachea and œsophagus. B, arch of aorta. C, carcinomatous mass. D, heart. E, lower portion of œsophagus. F, trachea laid open showing carcinomatous deposits in the interior. G, descending aorta. H, skin tube laid open (autoplasmic œsophagus). K, upper portion of œsophagus. At the bifurcation just behind the aorta where the handle of the probe crosses is a cauliflower mass, evidently carcinomatous.





## THE END RESULTS OF TREATMENT IN CERTAIN FORMS OF MALIGNANCY OF THE NECK\*

BY MARTIN B. TINKER, M.D.

OF ITHACA, N. Y.

THE difficulties in management of most cases of malignancy in the neck, far enough advanced so that a probable diagnosis can be made before operation, are so great that the average surgeon could not forget his experiences if he tried and the occurrence of the various forms of malignancy about which I have sought information is so infrequent, that most surgeons would not need to consult their records to recall with reasonable accuracy the number and essential facts regarding their cases. The information given in most reference publications is meagre and of doubtful reliability, and judging from the results of investigation of thyroid malignancy the literature is a very incomplete record of surgical experience in this field. Wilson<sup>1</sup> was able to collect 169 cases of thyroid malignancy in personal communications from sixty-seven American surgeons, not including those in the Mayo Clinic, none of which had been reported in the literature. "That is almost five times as many cases have been met with in the experience of a very small number of American surgeons as have appeared in the entire literature from all American sources." Believing that results in the management of other forms of neck malignancy were likewise mostly unreported and that knowledge of such experience should stimulate interest and further improve results, letters of inquiry were sent to all members of this Association. Ninety-eight replies were received. Sixty surgeons do not deal with this class of cases or are unwilling to express an opinion because of incomplete records or the fact that they have not recently been in active surgical work. Data of considerable value were received from thirty-eight. While the results reported are less encouraging than the results of treatment of malignancy in many other parts of the body, they do not justify the pessimism with which these cases are still regarded by many surgeons. In times past extremely radical operations have been performed, followed by low percentage of permanent cures which have tended to bring surgery into disrepute, and cases should be carefully studied and selected. In the interest of better end-results these cases may be treated in three main groups: Those in which operation is contra-indicated; those in which operation offers reasonable prospect of cure; and those in which, while operation gives little or no hope, Röntgen-ray or radium has proved of certain value in palliation and occasional cure.

In at least two forms of malignancy I believe that operation is usually contra-indicated, namely, metastasis to the neck from tonsillar or pharyngeal growths or from growths of unknown origin. So far as I have been able to determine, no cures have been reported in case of malignancy of the tonsil

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\* Read before the American Surgical Association, May 1, 1922.

or pharynx with metastasis to the cervical glands, and I believe in such cases palliative treatment by Röntgen-ray or radium should be advised. Dr. E. A. Codman has reported by personal letter one recovery following treatment with radium of extensive malignancy of the jaw with metastasis. A second group of cases in which I have personally never seen a cure is malignancy of the glands of the neck, evidently metastatic, in which the original focus cannot be located.

In the group in which operation offers a fair prospect of recovery may be included the early cases of malignancy of the thyroid; malignancy originating in branchial cleft remnants; carotid-gland tumors and tumors of the parotid. Personally, I believe that the early cases of Hodgkin's disease might also be included in this group.

In the third group, which in my opinion should be treated by radium or Röntgen-ray either with or without surgery, should be included the more advanced cases of Hodgkin's disease, advanced thyroid malignancy and advanced branchial cleft carcinoma.

There is quite general agreement as to the influence of methods and technic on end-results, but it seems impossible to give definite figures.

Permanent results, as with malignancy in any part of the body, depend upon complete extirpation of all diseased tissue wide of the growth and with all lymphatic glands in nearby territory. There is quite general agreement as to the value of "block dissection" in such cases. The importance of sharp dissection as opposed to blunt dissection of any form in dealing with malignancy has been emphasized for many years by Dr. W. S. Halsted and also by Dr. G. W. Crile. Two surgeons of this Association use the electric cautery instead of the knife in excision of certain growths.

Careful dissection requires a dry field and perfect light, and the results of these operations, both immediate and permanent, have apparently been improved by obtaining control of the main arterial supply early in the operation. Twenty-seven members of this Association state that they close the great vessels in one way or another; some rarely, many generally, and sixteen use some form of temporary closure, most frequently rubber-padded forceps as suggested by Crile. The flexible metallic bands used by Doctors Halsted and Matas are also of great help in some of these cases.

As to permanent closure with vessel suture it is possible to save considerably more of the large vessels of the neck, and where, as with carotid-gland tumors and many of the cases of extensive malignancy, it is necessary to divide the common carotid in order to completely eradicate the growth, the collateral circulation is specially important and the saving of a fraction of an inch as can be done with blood-vessel suture often makes much difference in the local circulation as well as that at the base of the brain. Following Matas, many surgeons all over the world have demonstrated the reliability of suture as a means of closing the great vessels in the cure of aneurism, but apparently few have applied this principle for similar reasons to secure closure

and saving collateral circulation in the management of malignancy. Seven surgeons report suture of the jugular for injury but none intentional suture of the arteries. I have sutured the carotids three times—twice for carotid-gland tumors and one branchial cleft malignancy—all these patients surviving the operation five years or more.

Venous oozing is very greatly diminished by putting the patients in a sitting position or tilting them in reverse Trendelenburg position with the head fairly high. We have seen no unfavorable results from either of these methods. Twenty-two members of this Association operate with the head of the table elevated while four prefer the patients flat.

Perfect definition of the tissues by real daylight or the daylight lamp greatly aids in distinguishing between certain forms of malignancy and the adjacent tissues.

The influence of anæsthesia on venous and arterial hemorrhage is very evident in neck surgery. All forms of general anæsthesia, even chloroform, give temporary rise in arterial blood-pressure and almost invariably a certain increase of carbon-dioxide in the blood with accompanying free venous ooze which in many of these cases makes perfect dissection impossible. Personally I always use local anæsthesia, although often in combination with general anæsthesia. If bleeding is troublesome removal of the general anæsthetic improves conditions very greatly. Local anæsthesia alone, in my opinion, gives much better results in certain cases, notably in parotid-gland tumors, where if we work close to the capsule serious injury of the facial nerve can almost invariably be avoided. While a majority of this Association (twenty-eight) expressed preference for ether, nine use gas-oxygen, three use local anæsthesia almost to the exclusion of ether, two prefer rectal ether anæsthesia and one avoids increased bleeding from elevated blood-pressure and venous congestion by withdrawing the general anæsthetic as soon as the skin incision is made and the exposure of the deeper parts is made.

As to results in various forms of neck malignancy reported by members of this Association:

*Hodgkin's Disease.*—A total of 183 cases were reported, with seventeen patients remaining well five years or more following operation; seventy-five of these cases were reported by Yates and eleven of his patients have remained well from five to twelve years. In terms of the standard form of reporting end-results of the Massachusetts General Hospital this gives nine per cent. of five-year cures. Three have abandoned operating in these cases, but I believe should reconsider. In cases far advanced the disease is undoubtedly followed by recurrence and death whatever form of treatment is used, but early operation when the disease is limited to a small group of glands should, I believe, be followed by many permanent cures. Röntgen-ray gives striking improvement even in many apparently hopeless cases, and it is possible that by its use some patients might be brought into the operable class. The real facts are difficult to get at because of confusion in the pathology.

In two of my earlier cases the patients have remained well six years and seven years. When the profession comes to the point of advising radical removal of every bunch of enlarged glands of the neck of more than a few months' standing, and in which reasonably conservative measures have been thoroughly tried, our percentage of permanent cures in Hodgkin's disease should greatly improve.

*Carotid-gland Tumors.*—Total number reported, twelve. These are probably mostly previously unreported cases. Operative mortality one, five-year cures 5, or a percentage of 41.6. The results of operation for tumors of the carotid body have been studied in this country first by Keen, by Randolph Winslow in a paper before this Association, by Lund, Mont Ried and many others. My experience in operation upon three patients corresponds with that of Winslow; that removal of the growth with the arteries gives a good prospect of permanent cure, but dissection from the vessels is more frequently followed by recurrence. Radical removal of the growth with permanent closure of the arteries above and below gave a cure of five years' duration in one of my cases and seven years in the second case, while dissection of the growth from the vessels was followed by prompt recurrence in a third case in spite of early and energetic radium treatment by Dr. H. A. Kelly.

*Thyroid-gland Malignancies.*—Total number of cases reported, sixty-two; one operative death and fifteen five-year cures, or a percentage of twenty-four plus. The total number of cases from the Mayo Clinic alone in which malignancy has been discovered by examination of the tissue after operation is 207, but a report as to the late results has not yet been given. In working out the questionnaire I neglected to ask for cases in which a diagnosis of probable malignancy was made before operation. Some state that in such cases far enough advanced to make a probable diagnosis before operation there is no possibility of cure, but at least four such permanent recoveries have occurred in the experience of members of this Association. The length of time that the disease is unrecognized and even unsuspected is often surprising. In most of my cases enlargement of the thyroid had existed at least ten years before the patient came for operation. When the public and the profession as a whole appreciate more fully the possible dangers of thyroid enlargement and we operate earlier the percentage of cures should be high. These cases are slow in their development locally, specially the large round-cell sarcomas, but in many instances metastasis has occurred to distant organs before the primary growth has been removed. One of my patients died four and one-half years after operation without any local recurrence but from metastasis to the spine. The earlier growths of the thyroid with operation before there has been extension beyond the capsule should be followed by permanent cure in most cases. Follow-up letters to 1318 of my former patients did not show any recurrence in cases which had not broken through the capsule in cases operated upon during the past sixteen years. In two of my cases with extensive malignancy of the thyroid of long standing, with infiltration of the

great vessel sheath and larynx, thorough removal of the growth followed by the use of radium has given cure of seven years' standing in one case and eight years in another.

*Branchial Cleft Malignancies.*—A total of fifteen cases was reported with an operative mortality of two and five-year cures three. The results in branchial cleft malignancy depend, I believe, largely upon the duration and extent of the growth. I have operated upon only two cases, with one death and one nine-year recovery. In the first, recurrence, for which secondary operation was performed, occurred two years after the primary operation and a second recurrence and death a year after the secondary operation. In the second case there was extensive involvement of the surrounding structures including the thyroid gland. All diseased tissues were removed down to the great vessel sheath, which was infiltrated with the disease and was left without attempt to thoroughly extirpate the growth after closure of the common carotid. This patient was sent to Dr. Howard A. Kelly for radium treatment and was living at last report nine years after operation. From reports of others and my own experience, it is my impression that early operation gives a reasonable prospect for cure and that certain of the apparently hopeless cases can be cured by radium.

*Parotid-gland Malignancies.*—A total of 170 was reported with twenty-two five-year cures. Parotid-gland tumors during the early stage of development are usually encapsulated, not very deeply located, mildly malignant, and if completely removed a permanent cure should result. When neglected for years, as seen by most surgeons, these tumors frequently extend deeply into the neck along the base of the skull, giving considerable difficulty in operation, though permanent cure is still possible. If through growth, trauma or incomplete operation the cellular elements escape from the capsule, involvement of surrounding tissues is often rapid, the growth becomes highly malignant, the lymphatic glands become involved and the prospect of permanent cure is greatly reduced. When the growth has not broken through, if the capsule of the gland is carefully followed, injury to the facial nerve can almost invariably be avoided. Sistrunk's<sup>2</sup> suggestions as to technic in avoiding the nerve are of great value in certain cases. The color distinction between the growth within the capsule and parotid-gland tissue is so slight that perfect light and a dry field are essential. Local anæsthesia is of great value, both in maintaining color definition and avoiding hemorrhage. I have operated upon eight cases which had not extended beyond the capsule, without injury to the facial nerve and with permanent recovery.

Doubtless almost all experienced surgeons have operated upon cases of the varieties mentioned without diagnosis of the true character of the disease. The likelihood of this is shown by Ried's<sup>3</sup> report of three cases of carotid gland from Johns Hopkins Hospital, who states that in one case the pathological report was perithelial angiosarcoma, but after operating upon the second case, six years later, the clinical similarities led to a restudy of the

growth, when its true nature was determined. Several writers do not feel inclined to class carotid-gland tumors among the malignant growths, but study of the literature and my own limited experience leads me to agree with Balfour<sup>4</sup> that these growths are, as a rule, malignant and recurrences after removal are frequent. The very small number of reports which have appeared in the literature probably does not at all represent what has been done in the treatment of this form of malignancy. Probably the relative frequency of most of these conditions is not as great as that of thyroid malignancy, but the total would still be large.

Although there is considerable individuality shown by members of this Association in the choice of the roads which lead to the best end-results, no very vital differences in methods are apparent. Undoubtedly both our immediate and permanent results will be improved if the campaign of education of the American Society for the Control of Cancer can be pushed with something like the energy that has been put into the campaign for the prevention of tuberculosis.

To sum up briefly, what, if anything, has been accomplished by this inquiry? It seems to me that the figures which I have given are relatively valueless as far as establishing anything like a standard as to what our results in these cases should be is concerned. But they do indicate reasonably clearly: (1) That the end-results in certain cases, usually considered mildly malignant, are perhaps not so good as is generally supposed. (2) That a number of reliable observers have seen permanent results follow the use of Röntgen-ray and radium. (3) That certain forms of neck malignancy considered hopeless by some competent surgeons have been and are being operated upon with apparent permanent cure by several members of this Association.

#### REFERENCES

<sup>1</sup> ANNALS OF SURGERY, August, 1921, p. 129.

<sup>2</sup> Minnesota Med., March, 1921.

<sup>3</sup> Johns Hopkins Hospital Bull., June, 1920, vol. xxxi.

<sup>4</sup> Surg., Gynec. and Obst., February, 1914, p. 203.

## END RESULTS OF OPERATIONS FOR CANCER OF BREAST\*

BY FRANK E. BUNTS, M.D.

OF CLEVELAND, OHIO

I HAVE not attempted in this paper to collect statistics from literature but rather to present the available records of the end-results of operations for cancer of the breast performed by my associates and myself. The personal equation enters so largely into the computation of statistical results that it would seem best to me to let each report stand upon its own basis rather than seek to obtain an average of the results of many different reporters. Such averages are useless as far as conclusions of any value are concerned. So many factors enter into the outcome of every case that I sometimes feel that the old method of approach, that of a careful study of the individual case, might be of the greatest value.

Into such an analysis must enter the question of heredity, for even if cancer be not hereditary there may at least be an inherited predisposition to it in certain individuals. The end-result is affected not only by the type of cancer, but probably even more by the age of the patient. The stage of growth also has its uncompromising influence, as do also the degree of metastasis, the regions or parts invaded, the physical resistance of the patient, and the willingness of the surgeon to operate in advanced cases if only to relieve pain and discomfort. All of these factors have their bearing upon the so-called end-results, and accordingly the preponderance of one or another of these factors in any series, might make the statistics of that series absolutely valueless as a basis of comparison with another group in which some other factor or factors preponderate.

The type of operation is often stressed, but this again seems to me to be of little more than secondary importance. The extent of the operation; the removal of the supraclavicular as well as of the axillary glands; the removal of extensive areas of skin, of one or both pectoral muscles, or of only part of one; the removal of the upper part of the aponeurosis of the rectus muscle—the value of any of these cannot in my opinion be based upon statistics but must depend to a great extent upon the operator's own experience, upon his estimate of the indications as he finds them in each individual case.

A study of the end-results of any series of cases, in particular of cancer, requires that note be taken not only of the treatment and the later course, but also of the incidence, possible etiological factors, and in particular the duration of symptoms before treatment; for it is impossible to foresee to what extent later studies may link the prognosis, even primarily, to one or more of these as well as to the method of treatment. Therefore, in this study of 600 cases of carcinoma of the breast which have been under the care of

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\* Read before the American Surgical Association, May 2, 1922.

my associates and myself, an attempt has been made to investigate the above points as well as the post-operative data.

In 553 of these cases the growth was primary; in 47 there were recurrences after previous operation elsewhere. These latter cases have not been included in this study.

As to the incidence, our oldest patient was eighty-four years of age, the youngest nineteen, the average age being approximately fifty years. The prognosis appears to be in inverse proportion to the age of the patient.

Regarding etiology, we were surprised to find a definite history of trauma in only seventy cases—12.6 per cent.; while in 105, or 19 per cent., the patient gave a hereditary history of cancer. While, of course, one cannot entirely depend upon the statements of every patient—which too often are based upon impressions rather than certain knowledge, nevertheless, such a large percentage as is given in the latter figure certainly appears to be very significant.

The peculiar danger of the painlessness of the earlier stages of new growths in the breast is emphasized by the facts: (1) That the presence of pain or tenderness was noted in only 251 of these histories, among which it was a first symptom in but 48 cases; and (2) that in 222 cases axillary involvement was diagnosed before operation, the involvement including the supraclavicular glands in 21 cases, the skin in three, the inguinal glands in one, the liver in one, and the femur in two.

Whether the delay before operation after a lump was first noticed in the breast was due to advice from the attending physician or to the reluctance of the patient to submit to operation cannot be known. These periods are given in the following table:

*Duration of symptoms*

(from time lump was first noticed.)

Less than 1 month.....	37
1-6 months.....	153
6 months—1 year.....	81
1-2 years.....	97
2-3 years.....	38
3-5 years.....	33
5 years .....	6
6 years.....	3
7 years.....	2
8 years.....	1
9 years.....	1
Over ten years .....	23

Fortunately the results of the cancer propaganda of the past few years are already being manifested in our clinics by the promptness with which patients with lumps in their breasts are being advised to consult a surgeon, and the increased readiness with which the patients themselves submit to operation.



## OPERATIONS FOR CANCER OF BREAST

As for the later course of our 540 operative cases it has been possible to trace 341. Of these 174, or 51 per cent., are living, the length of life to date being distributed as follows:

Less than 3 years.....	80
3-5 years.....	13
5-10 years.....	47
10-15 years.....	18
15-20 years.....	12
Over 20 years.....	4

Among the 167 cases who have died since operation, ten died in the hospital and the duration of life of thirty is not known. Among the remainder, the duration of life was as follows:

Less than one year.....	42
Between one and two years.....	27
Between two and three years.....	19
Between three and five years.....	20
Five years.....	5
Six years.....	4
Seven years.....	1
Eight years.....	2
Nine years.....	2
Thirteen years.....	2
Fifteen years.....	1
Seventeen years.....	1
Eighteen years.....	1

Among these the cause of death is given as metastasis, 61; recurrence, 13; pneumonia, 5; cancer, 7. It would seem almost certain that the deaths listed above as due to pneumonia and cancer should also be classified as due to metastases. The remaining eleven died from causes which were not related to the operation or the diseases, *viz.*—one each from dropsy, cholelithiasis, nose-bleed, heart trouble, tuberculosis, hyperthyroidism, diabetes and "stroke," typhoid fever, stomach trouble, neuritis and old age.

Unfortunately in our study thus far we have not linked the end-results with the character of the involvement and the extent of the operation in the various cases. Such data will be offered in later reports.

As for recurrences, we have reports of 72 among the 341 cases whose later post-operative history has been traced. The location of these recurrences is given in the following table. (See next page.)

A few especial comments are suggested by these figures and by the experience of my associates and myself in individual cases.

The tendency of recent years has been away from the more extensive deforming operations. J. B. Murphy was among the first to advocate less resection than is required, for example, by the Halsted operation.

# FRANK E. BUNTS

## *Recurrence and Metastases*

### I *Single*

Near incision.....	17
In axilla.....	9
In breast.....	15
In opposite axilla.....	2
In opposite breast.....	5
In glands of neck.....	1
In spine.....	2
In pectoral region.....	1
In thoracic wall.....	2
In scalp.....	1
In femur.....	1
In uterus.....	1
Carcinomatosis.....	2

### II *Multiple*

Near incision and opposite breast.....	1
Near incision and breast.....	1
Near incision and glands of neck.....	3
Near incision and axilla.....	2
Near incision and chest.....	1
In axilla and glands of neck.....	2
In axilla and glands of neck and chest.....	1
In axilla and glands of neck and breast.....	1
In scalp and shoulder.....	1

The periods within which the recurrences appeared were stated in 63 cases, among which they occurred in less than six months in 28.5 per cent., from six months to five years, 55.5 per cent., and after five years in 15.3 per cent.

The following table gives the complete report of this series:

#### *Period after operation when recurrence or metastasis appeared*

Within 6 months.....	18
6 months—1 year.....	14
1—2 years.....	10
2—3 years.....	6
3—5 years.....	5
5 years.....	3
7 years.....	1
8 years.....	3
10 years.....	2
25 years.....	1

In the experiences of my associates and myself there have been few recurrences in the skin, excepting in cases in which massage had preceded the operative treatment, and these have yielded readily to X-ray or radium.

## OPERATIONS FOR CANCER OF BREAST

Recurrences in the liver were not much more frequent than recurrence in the opposite breast or axilla, and if we were to follow logically the theory which had led many to adopt the routine removal of the upper sheath of the rectus we might also feel it necessary to remove the opposite breast and to dissect out the opposite axilla.

Our statistics indicate clearly that it is useless to fix an arbitrary time after operation when, if no recurrence has been noted, the cancer shall be considered cured—a three-year or even a five-year limit means little or nothing, for recurrences have taken place after more than fifteen years. It may be objected that these late cases are not recurrences but are new cancer growths. Possibly so, but certainly in view of the varying dates at which undoubted recurrences do occur, it is not possible arbitrarily to set a date at which they shall be deemed new growths and not metastases.

The wide range of tissues within which recurrences are found makes it difficult indeed to conceive of a sufficiently extensive operation to prevent the possibility of such a termination. In our earlier cases we uniformly gave X-ray treatment after operation, but while this appeared to benefit many, there were other cases in which the unusually rapid recurrence made us hesitate to continue this procedure as a routine. The explanation of the uncertainties of the X-ray treatment may perhaps be that in some instances we were getting a real therapeutic dose, which is always of benefit, while in others, owing to the uncertain measurement of the X-ray dosage, we only secured the stimulating or irritation dose which facilitates rather than retards growth. With the establishment of more certain methods for measuring the dosage, we have tentatively resumed the use of the X-ray and are carefully watching the results. The use of deep X-ray therapy in the treatment of cancers of the breast to the exclusion of operation opens a hopeful, but thus far non-productive field of speculation.

### CONCLUSIONS

The successful treatment of cancer of the breast as of any other pathological condition should be strictly individualized.

The ultimate sequelæ depend more upon the stage and dissemination of the growth when it is presented for treatment than upon any defined method of operation.

Greatly increased data regarding the value of the pre- and post-operative use of the X-ray and of radium are required before final conclusions can be drawn, although there seems little doubt of the value of radium applied directly in the axilla.

The substitution of the X-rays or of radium for surgical treatment cannot safely be considered at the present time.

The early removal of any growth remains the one and only sure method of treatment.

## END RESULTS OF OPERATIONS FOR CARCINOMA OF THE BREAST\*

BY HOMER GAGE, M.D.

AND

DONALD S. ADAMS, M.D.

OF WORCESTER, MASS.

WE present herewith the results of 101 consecutive operations for cancer of the breast performed between 1905 and 1919. They were not selected cases. None were refused operation, no matter of how long duration or how far advanced, unless it were perfectly plain that the disease was quite impossible of removal.

They are therefore not an index of what can be done in carefully selected cases, but what may be expected in the average run of cases as they present themselves at the clinic or hospital for opinion and advice.

Of the 101 cases, in 93 a radical removal was attempted, including in the incision a wide margin of skin and excising the breast, both pectoral muscles and the axillary contents en masse. In seven, a partial operation was done; the breast was removed without the underlying muscles and without opening the axilla. This was done sometimes because malignancy was not suspected until the pathological report was received; and in others because the patient's general condition was such that a major surgical procedure seemed unwarranted.

In all the cases careful microscopical examinations were made of the breast and axillary contents by Dr. F. H. Baker, pathologist to the Worcester City Hospital, or by Dr. Roger Kinnicutt, pathologist to the Memorial Hospital.

There were two deaths; one from a partial operation, undertaken in the presence of a serious heart lesion in the hope of avoiding a cancerous ulcer—death on the eighth day from cardiac complication; and one about a month after operation from what was said to be diphtheritic infection of throat and subsequently of wound.

### TABLE I

Number of cases 101.

Covering years 1905 to 1919 inclusive.

Average age, 53 years.

Youngest, 25.

Oldest, 80.

21 per cent. single, oldest 71, youngest 25.

79 per cent. married, oldest 80, youngest 32.

Left breast affected, 59 per cent.

Right breast affected, 41 per cent.

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\* Read before the American Surgical Association, Washington, May 21, 1922.

## CARCINOMA OF THE BREAST

Predominating type of lesion, adenocarcinoma.

Average time between patient's discovery  
of breast condition and operation, 14 months.

Shortest time, 1 month.

Longest time, 10 years.

Percentage of patients dead, due to cancer, 68 per cent.

Percentage of patients dead, other causes, 11 per cent.

Percentage of patients alive over period of  
3 to 16 years, 17 per cent.

Deaths due to general cancer, 44.

Deaths due to visceral metastases, 12.

Deaths due to lymphatic metastases, 9.

Deaths due to bone metastases, 3 (femur 2, sternum 1).

Inconclusive cases, 2.

### *Group I*

Cases without recurrence, alive and well, 13.

Time elapsed since operation:

In 2 cases 3 years.

In 2 cases 4 years.

In 1 case 5 years.

In 1 case 6 years.

In 2 cases 8 years.

In 1 case 9 years.

In 4 cases 10-16 years.

Average 7.1 years.

Average time between discovery of condition  
and operation, 6 months.

Shortest, 2 months.

Longest, 2 years.

Axilla involved, 36 per cent.

Axilla not involved, 64 per cent.

### *Group II*

Cases with local recurrence, and still alive, 4.

Time of recurrence after operation,

1 year

2 years

3-6 years

4 years

Length of time since last operation,

10 years

7 years

3 years

3 years

Average, 5-7 years.

Average time between discovery of tumor and operation, 7 months.

Longest, 1 year.

Shortest, 6 weeks.

Axilla involved, 66 per cent. Not involved, 34 per cent.

## GAGE AND ADAMS

### *Group III*

Cases with no local recurrence, but dead, 35.

Time after operation to death:

6 mos. to 2 years,	26.
4 years,	1.
5 years,	3.
6 years,	1.
7 years,	3.
8 years,	1.

Causes of death:

General cancer,	23.
Visceral metastases,	6.
Lymphatic metastases,	4.
Bone metastases,	1.
Cardio-renal,	10 days.

Average time between discovery of tumor and operation, 2 years.

Axilla involved, 84 per cent. Longest, 6 years.

Axilla not involved, 16 per cent. Shortest, 1 month.

### *Group IV*

Cases having local recurrence which are dead, 39.

Time of local recurrence:

6 mos. to one year,	22.
2 years,	8.
3 years,	2.
4 years,	1.
5 years,	2.
6 years,	1.
7 years,	1.
9 years,	1.

Length of life after operation:

6 mos. to 1 year,	17.
2 years,	10.
3 years,	3.
4 years,	2.
5 years,	2.
6 years,	3.
9 years,	1.

Metastases causing death:

General cancer,	25.
Visceral cancer,	6.
Lymphatic cancer,	5.
Bone cancer,	1.

Average time between discovery of tumor and operation, 2 years.

Longest, 10 years. Axilla involved, 80 per cent.

Shortest, 2 months. Axilla not involved, 20 per cent.

# CARCINOMA OF THE BREAST

## Group V

Cases having no local and no general recurrence, but dying of other causes, 10.

Time after operation:

3 years,	1.
4 years,	1.
5 years,	3.
6 years,	2.
7 years,	7.
9 years,	1.
15 years,	1.

Causes of death:

Cardio-renal,	4.
Apoplexy,	3.
Pneumonia,	1.
Infectious Arthritis,	1.
Accidental poisoning,	1.

Average time between discovery of condition and operation, 10 months.

Longest, 2 years.

Shortest, 1 month.

Axilla involved, 25 per cent.

Axilla not involved, 75 per cent.

Last year in a report of the End Results in Cancer of the Breast from the clinic of the Massachusetts General Hospital, Doctors Greenough and Simmons tabulated their statistics in a manner that is readily copied, and if followed by other reporters, makes comparisons and combined statistics easily available. We have, therefore, made a similar table from the results of our own studies:

TABLE II

Total entries, carcinoma breast,	101.	
Re-entries, (entered more than once),	0.	
Recurrence from previous operation,	0.	
Cases available for study of operability, mortality, etc.,	101.	
Radical operations,	94.	
Partial operations,	7.	
No operation,	0.	
Operative deaths,	2.	
Operative mortality,	2 per cent.	
Operability: radical operations:	93.5 per cent.	
Operability: all operations,	100 per cent.	
Inconclusive cases: lack pathological examination,		0.
Inconclusive cases: untraced,		1.
Inconclusive cases died within time limit, without recurrence,		1.
Cases available for end results data,	99.	
Radical operations,	92.	
Partial operations,	7.	
No operation,	0.	
Number cases alive and well,	17.	
Number cases died without recurrence,	10.	
Number 3-year "cures" all operations,	27.	
Number 3-year "cures" radical operations,	24.	
Percentage of "cures" (all operations),		27 per cent.
Percentage of "cures" (radical operations),		26 per cent.

Although we are still far from any accurate knowledge of the cause of cancer of the breast, surgical opinion is pretty well agreed that it begins as a purely local process; that there must be a precancerous stage, and that the recognition of that precancerous stage is, from the standpoint of effective therapy, the most important object of investigation.

There are many forms of benign growth in the breast, some of which remain benign and may be retained for years without danger. But we believe the instances in which malignancy has followed a history of a tumor which has been present for a long time without evidence of growth or change, and without symptoms of any kind, are too many to be ignored; and are therefore firmly of the opinion that a tumor in the breast is always a menace.

The seriousness of the menace varies directly according to the age of the patient but is never negligible. We believe therefore that it is better to advise removal of any persistent tumor.

Furthermore we have been interested in the study of discharges from the nipple, and were not a little surprised to see in a recent admirable study of benign tumors of the breast the statement that: "The old theory that a discharge from the nipple called for removal of the breast was based on fear, and not on fact." †

In five of the cases here reported, or in approximately five per cent., a bloody discharge from the nipple was the first symptom observed, followed by a tumor, which in four cases was pronounced adenocarcinoma; the fifth will be mentioned later; of these four cases, one is living and well nine years after operation; one died of apoplexy two years after operation without recurrence, and two died of general carcinomatosis.

The fifth case was watched with unusual care for three years; it presented an intermittent serosanguinous discharge from the nipple, and after three years a small tumor, size of pea, could be felt near the margin of the areola; the breast was removed, and the lump proved to be a thickened and dilated milk duct from the wall of which projected a small papillary tumor which proved on microscopical examination to be cancer.

A sixth case has just come under our observation, which seems to add strong confirmation of our suspicion of these bloody discharges from the nipple. The patient presented herself in November, 1921, on account of an intermittent bloody discharge which had appeared within three months. Absolutely nothing could be found on most careful examination of the breast, and there was at the time no discharge. She was asked to report again in three months.

In March she reappeared with a history of continued discharge, a defined hardness in inner half of left breast, pressure on which started a bloody discharge from the nipple. Examination of the breast after operation showed numerous small cysts, especially in inner and upper quadrant of breast and a clearly defined area of adenocarcinoma with many mitotic cells.

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† Journal A. M. A., vol. lxxviii, No. xii, p. 860.



## CARCINOMA OF THE BREAST

Our experience has therefore been distinctly suggestive of a direct sequence from bloody discharge to cancer; certainly the appearance of a tumor in the breast after a chronic discharge from the nipple is an imperative indication for operation; we cannot help feeling that when the possibility of a subsequent malignancy is involved, the preliminary sign is fact enough to occasion fear and to warrant the removal of the breast. We are strongly of the opinion that any suspicion of pathology in the breast demands earliest possible surgical interference.

The number of cases included in this report is too small to warrant any definite conclusions. It may be of value in the compilation of a large number of end results, and even then it must be remembered that this represents a group in which operation was never refused when the visible and tangible evidences of disease were removable; not a group selected with a view to favorable results.

The only inferences which may properly be drawn are, we think:

1. No time limit can be set beyond which recurrence may not occur.
2. Absence of malignant infiltration of axillary glands warrants much more favorable prognosis.
3. Any lump in the breast is to be regarded with suspicion and carefully watched.
4. Its persistence, and especially its activity, as indicated by increase in size, is ground for its removal, though not necessarily involving removal of entire breast.
5. A continued discharge from the nipple means pathology in the breast, must be kept under close observation, and be regarded with suspicion.

## THE END RESULTS OF OPERATIONS FOR CANCER OF THE BLADDER\*

BY WILLIAM E. LOWER, M.D.

OF CLEVELAND, OHIO

THE desideratum in reporting the end-results of any series of cases is to present information which will aid in determining the relative value of different methods of treatment. Only the collected experience of many observers over a fairly long period of time can be of final value, and it is, therefore, obvious that only by some uniform method of reporting end-results can such a collective study be made possible.

The need of such uniformity has been impressed upon me in my effort to gain information regarding the end-results of the treatment of malignant tumors of the bladder on account of the lack of the uniformity of the reports which have appeared in the literature, especially as regards diagnosis and the results of the various methods of treatment. For example, some authors consider that all bladder tumors are potentially malignant while others depend entirely upon histologic findings.

The methods of classification also vary greatly. Buerger's classification which has been rather widely adopted is as follows:

1. Papilloma.
2. Infiltrating papilloma.
3. Papillomata with early changes into carcinoma.
4. Primary papillary carcinoma:
  - a. Papillary polypoid type—carcinoma, Type I.
  - b. Secondarily infiltrating carcinoma—carcinoma, Type II.
5. Primary squamous-celled carcinoma:
  - a. Infiltrating type derived from papilloma.
  - b. Squamous type derived from papillary tumors.
  - c. Those derived from the prostate.
  - d. Metastases from source outside of the bladder.

Geraghty, writing in 1916, classified tumors from the therapeutic standpoint as papilloma, benign and malignant; papillary carcinoma, and adenocarcinoma. Malignant papillomas histopathologically, of course, are as much cancer as are papillary carcinomas, but Geraghty does not classify a malignant papilloma as a papillary carcinoma until the growth has begun to infiltrate the bladder wall.

Judd and Harrington make a general division of bladder tumors into two classes, one consisting of those which can be satisfactorily treated by endovesical methods and the other of those requiring operation; while Uhle and MacKinney say "there are practically two types of tumor, those amenable

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\* Read before the American Surgical Association, Washington, May 1, 1922.

to high-frequency destruction and those that must be dealt with by radical operation."

It should be borne in mind that it is often impossible to determine absolutely the type of growth even by a frozen section at the time of operation, for, as is well known, in many cases a section from the outer edge of a tumor will not show any malignancy, while malignant changes will be manifest in a section through the base. We believe, therefore, that the cystoscopic picture which shows whether the tumor is pedunculated or sessile, whether it is encrusted or sloughing, whether it is simple or multiple—these findings being interpreted in their relation to the age of the patient—that this picture is about as dependable as any method of diagnosis.

The three cardinal symptoms of bladder tumor are hæmaturia, pain and frequency of urination. As indicated above, however, the diagnosis of an intravesical neoplasm cannot be made from the symptoms alone, but must be established by cystoscopic findings.

According to Barringer the clinical findings pointing to malignancy are:

1. Induration (by rectal or vaginal examination or by cystoscopy).
2. Slough. Only malignant tumors slough.
3. Lack of reaction to fulguration. Braasch states that if a tumor does not respond to three or four treatments by high-frequency current, it may readily be concluded that it is malignant.
4. Age of patient. The older the patient the more likely the growth is to be carcinoma.
5. Multiplicity and size of tumor. So-called benign tumors are more apt to be multiple.

In the literature the inoperability of a large proportion of cases of bladder tumor is rightly attributed to the length of time which elapses between the occurrence of the first symptoms and the operation. In this day when the diagnosis of bladder tumors is comparatively easy, these cases should reach the surgeon earlier. Lynch quotes a series of 115 cases in which 70 per cent. had had symptoms for from one to four years and 40 per cent. for from three to four years. In a series of 75 cases Caulk places the average duration of symptoms as ten years, while Judd reports that in a series of 181 cases the average duration of symptoms was twenty-six months. Thomas gives the duration of symptoms in a series of 62 cases as from two weeks to twenty-five years. Tardy recognition of the condition is certainly not due to lack of symptoms but rather to a lack of appreciation of the importance of the symptoms. Whether the fault lies with the general practitioner in failing to send patients with hæmaturia to those properly equipped to make an early diagnosis or with the urologists themselves in failing to acquaint the general practitioner with the necessity of speedily subjecting every case of hæmaturia to cystoscopy so that growths can be cared for in their incipency, is a debatable point. Blood in the urine is always pathological—never physiological. The doctor who is first consulted for hæmaturia must himself diag-

nose or have some one else diagnose the cause of bleeding before any treatment is inaugurated.

*Methods of Treatment.*—As this report deals with end-results for operations of carcinoma of the bladder we can only consider such methods of operation as have been in use long enough for statistics regarding them to be of value. We must therefore confine ourselves to a study of the end-results of surgical treatment—*i.e.*, the removal of the tumors by excision or by the use of the actual cautery. The results of recent methods of treatments by some form of radiation—radium or the X-ray—cannot properly be included at this time, not because we believe this may not be the method of choice in the future, but because sufficient time has not elapsed for the end-results to be established.

We still believe that carcinoma is a local disease and that the rational treatment is complete and radical excision of the involved area; that the disease remains local for a long period of time and does not metastasize readily. Every effort, therefore, should be made to get rid of the local involvement. Gardner, in 1915, drew the conclusion that in the treatment of carcinoma of the bladder the transperitoneal method or subtotal cystectomy, with wide resection of bladder wall, offered the best method. I do not believe that surgeons now feel that the transperitoneal method is the method of choice. A freer dissection of the bladder from the peritoneum, the walling off of the surrounding structures before the bladder is opened, the better protection of the tissues and, where it is possible, clamping around the tumor before the bladder is opened and cutting on the bladder side of the clamp, seem to offer an efficient method of preventing contamination and the transplantation of cancer cells.

*Recurrence.*—Albarran has stated that all vesical tumors are malignant or likely to become so. In Clado's opinion "recurring tumors following upon removal of benign papilloma are always in the form of malignant epithelioma." Young, in 1913, asserted that benign tumors are relatively infrequent and unless cured almost always become malignant. Judd and Sistrunk believe that most of the recurrences come within the first few months after operation, their statistics showing that if the patient can survive the first year, his chances to remain well are increased. Geraghty feels that patients with multiple tumors seem more prone to recurrences than those with only one tumor and that the tendency to recurrence grows progressively less with each successive year.

This tendency of tumors of the bladder of all grades of malignancy to recur, whatever the method of removal or the thoroughness of operation, has long been recognized. Eternal vigilance is required. These patients must be advised to return at stated intervals for cystoscopic examination. The intervals between the successive examinations should be: three months, three months, six months, six months, six months, one year, one year, and one year, thus covering a total period of five years. If there is no recurrence during

this five-year period, it may be considered reasonably certain that there will be no further trouble. By using a small cystoscope the recurring examinations are practically painless. This is an important point, as patients will not return for repeated examinations if suffering is entailed.

*End-results.*—As to the end-results of the strictly surgical treatment of carcinoma of the bladder the data which we have been able to secure from the literature are about as follows:

In 1915 Gardner reported on 1702 cases of bladder tumors. Of this total 369 cases had been collected by Gardner himself. Of the personally compiled series there were 178 carcinomata. In 58 the bladder was partially resected and in 86 the growth was excised. The operative mortality was 27.5 per cent. for the resections; the percentage of recurrence in less than three years was 43.9, but only 2.4 after three years; the percentage of freedom from recurrence in less than three years was 36.5 and after three years was 17. The operative mortality for excisions was 14 per cent.; the percentage of recurrences in less than three years was 76.3 and after three years was 5.5; the percentage of freedom from recurrences was 18 in less than three years and after three years was one.

In 1917 Geraghty reported a series of 146 cases, of which 74 were papillary carcinomata. Eighteen, or 25 per cent., of the 74 were operable. Of the 18, eight had died since operation, and of the ten living seven had been living less than a year, one for four years, one for five years and one for six years.

Thomas, in 1920, reported 62 cases. Of the 18 subjected to operative procedures 50 per cent. died in the natural course of their disease, excepting two operative deaths—a mortality of 14.3 per cent. No statement is made as to the exact number of carcinomata among 18 cases operated upon and the lapse of time since operation is not given for the nine survivors.

Scholl, reporting in 1922, states that of the 333 cases of bladder tumors treated at the Mayo Clinic between 1910 and 1920, 216 were operable. "One hundred and four (48.2 per cent.) of the 216 from whom tumors have been removed completely are alive, an average of 3.2 years after operation; 112 (51.8 per cent.) are dead, an average of eight months after operation." Among the 168 epithelial tumors removed at operation there were 71 malignant papillomata and 94 solid carcinomata. "Twenty-six (36.6 per cent.) of patients in the first group have been dead on an average of eleven months after operation, in contrast to 67 (71.2 per cent.) of the latter group who died on an average of seven and one-half months after operation. Forty-five (43.4 per cent.) of the patients with malignant papillomata are alive on an average of three years and three months since their operation, in contrast to 27 (28.8 per cent.) of the patients with solid carcinoma who are alive on an average of two years and three months."

*End-results in Personal Series.*—My personal records include 222 cases of bladder tumors, among which 108 were malignant growths. Operations

were performed in 81 of these with an operative mortality of 9.8 per cent. Excision was employed in 59, or 72.8 per cent., of these cases, the cautery was used in 10, combined with surgery in 8, and transplantation of the ureters was performed in 4 cases, in two of which extirpation of the bladder was done also.

We have data regarding the length of life of 61 of the cases operated upon, and of 12 of those not operated upon. Among the former, 41, or 67.2 per cent., have died, 21, or 51.2 per cent., in less than one year after operation; the length of life of the remaining 18 being distributed as follows: 9, less than two years after operation; 3, between two and three years after operation; 1 within five years after operation; the length of life being unknown in the remaining five. Among the 22 cases still living after operation, the length of life has been as follows:

8—less than 1 year  
5—between 1 and 2 years  
4—between 2 and 3 years  
1—5 years and 9 months  
1—6 years  
1—8 years and 10 months  
1—10 years  
1—11 years

Among the twelve cases not operated upon, seven have died, six in less than one year after the consultation; the date of death of the other not being known. Of the remaining five non-operative cases two are living less than a year after the consultation, and three between one and two years.

Among these cases of carcinoma of the bladder we have records of recurrences in 18, the length of time between the operation and the first recurrence varying from one month to one and a half years, with one case in which the first recurrence was noted after eight years. In seven cases there was a second recurrence from one to four months after the first; in one case two recurrences after the first at successive intervals of three months each; and in another three recurrences after the first at intervals of two, ten, and five months, respectively. This last case is still living, two and a half years after his primary operation.

A study of the end-results in their relation to the type of operation has yielded the following figures:

Treated by excision .....	64 per cent.
Recurrence in .....	30 per cent.
Living over 5 years .....	7 per cent.
2 cases living over 5 years with no recurrence (6 years, 11 years)	
2 cases living over 5 years with recurrence (9 years 10 years)	
Treated by cautery .....	10 per cent.
Living over 5 years .....	1 (6 years)
Recurrences .....	0

Of equal value from the subjective point of view of the patient, certainly, with his length of life, is his economic status. Unfortunately we have data regarding this point in only a limited number of our living cases of carcinoma. Of these, 62½ per cent. report that they are able to do full work, that is, that their economic status is 100 per cent. restored; 12½ per cent. were able to do part-time work, and 25 per cent. report that they are unable to do any work.

#### CONCLUSIONS

The following conclusions are drawn from the available data of cases reported in the literature in this country and from my own series:

1. A large percentage of the malignant cases are of papillary origin, which means that they were referred late to the surgeon.
2. The percentage of recurrence is great whatever the method of operation, whether excision or cauterization.
3. Recurrence is no contra-indication for treatment, as some of the best results have resulted from operation on cases with recurrences.
4. Repeated observation after operation is absolutely essential if the mortality of carcinoma of the bladder is to be reduced.
5. The good results of the treatment of recurrences are due to the fact that recurrences are nearly always local and very seldom metastasize.

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# RESULTS OF THE TREATMENT BY RADIATION OF PRIMARY INOPERABLE CARCINOMA OF THE BREAST\*

A REPORT OF 83 CASES TREATED IN THE BREAST CLINIC AT THE MEMORIAL  
HOSPITAL OF NEW YORK, N. Y.

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SINCE the establishment of the breast clinic at Memorial Hospital in the fall of 1919, there has been a systematic effort to study the whole problem of carcinoma of the breast. Beginning with the pioneer work done by the late Dr. H. H. Janeway, prior to 1919, considerable progress has been made in the treatment of inoperable mammary cancer by radiation, and the present report includes not only the cases under my own supervision, but also those of my colleagues at the hospital. All of the patients were admitted in the years 1918, 1919, and 1920, leaving a period of sixteen months since the last case under report began treatment.

A primary inoperable breast carcinoma is one in which one or more of the following factors are present:

- A. Fixation of the breast tumor itself to the chest wall.
- B. Involvement of the supraclavicular nodes.
- C. Definite involvement of the opposite axillary nodes.
- D. Diffuse subcutaneous nodules.
- E. Diffuse inflammatory carcinoma involving a considerable skin area.
- F. Chest metastases—pleural or mediastinal.
- G. More remote metastases.

All surgeons will not perhaps be in accord with these indications of inoperability.

A. We believe that fixity to the chest-wall places the patient in the inoperable class. Under these circumstances several additional areas are usually the seat of the disease.

B. We have considered involvement of the supraclavicular nodes a sign of inoperability because we believe that a complete dissection of this area is practically impossible without a division of the clavicle itself. We have taken this position after careful consideration of the usual course of the cases with supraclavicular involvement, with and without operation.

In the clinic, several cases which we had considered inoperable because of supraclavicular involvement, and were treating by radiation, have gone elsewhere and had a radical operation performed. One such case entered the clinic with definite, small, hard supraclavicular nodes. She returned six weeks later following a radical amputation, with the supraclavicular nodes three times as large as when we first saw her, and in spite of any type of radiation, is rapidly succumbing to the disease. In our judgment, this patient

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\* Read before the American Surgical Association, May 1, 1922.

was made distinctly worse by the radical procedure adopted. We have also noted that a definite fullness in this region often precedes the appearance of distinct nodes, the first node usually palpable, being the one directly behind the inner end of the clavicle. Nevertheless, this sequence is not invariable, and we consider the case inoperable only when definite, firm nodes may be palpated.

C. If the surgeon cannot palpate axillary nodes, it is no proof that numerous small nodes may not be present, but when a definite hard node is to be felt in the opposite axilla, one may feel reasonably sure that this indicates carcinomatous involvement. Not infrequently we have found the opposite axilla the seat of disease, often without apparent involvement of the opposite breast.

D, E. No question can exist in the mind of any surgeon, that the patient is inoperable in the presence of diffuse subcutaneous nodules, or diffuse cancerous involvement of the skin. We have numerous examples of these types of metastases in the clinic, treated by operation or radiation,



FIG. 1.—Case No. 83, C. A. Untreated cancer of the breast. Patient lived twenty-two years and five months.

or by both methods, and we have a very deep conviction that radiation offers much the better outlook for the patient.

F, G. No one can doubt that pleural and mediastinal metastases, as well as a spread of the disease to remote areas, indicates inoperability.

A case having been classified, two questions are asked concerning it:

First: What can we do for this patient?

Second: What may we learn from this patient?

A. What can be done for the primary inoperable carcinoma of the breast?

1. Check considerably the rate of growth of the carcinoma, frequently causing a considerable regression and at times a disappearance of the carcinoma. The persistence of a mass in the breast may not necessarily indicate that active carcinoma is still present. Fibrous tissue replacement may leave

a definite hard tumor mass, which may be misleading in estimating the exact effect of radiation upon the tumor itself.

2. Involved nodes in the axillary or supraclavicular regions may be expected to regress considerably, and in some instances they have entirely disappeared under treatment by radiation.

3. A fixed breast tumor may be rendered mobile, permitting a palliative operation with removal of the breast itself, eliminating the possibility of subsequent ulceration. Four of our cases who are doing particularly well received this type of treatment (25, 36, 46, 56).



FIG. 2.—A. F. Inflammatory cancer of the right breast. A type which rapidly recurs if operated upon.

4. Relieve in some measure the patient's discomfort and pain. The effect upon spinal metastases has been variable, but in a few instances there has been a marked relief of pain over a considerable period.

One is compelled to admit that certain cases presenting themselves at the hospital are altogether too advanced to hope for any good result by any means of treatment. Too much emphasis cannot be placed upon the un wisdom of promising patients with advanced disease remarkable results from radiation or any other form of treatment. Such cases, however, are often given mild X-ray radiation for the moral effect, but the family are told what we believe to be the truth concerning the case. The Social Service Department of the hospital has done a fine humanitarian work in the care of these patients—dressing ulcerating areas where home conditions of the patients permit it, and providing for the entry of other cases into institutions devoted to this incurable group.

But the surgeon may ask at once, Is not this a general disease and what of the mediastinal, pleural, and pulmonary metastases, as well as those of the spine, liver, etc. ? We fully appreciate the rapidity with which dissemination occurs and are convinced that it spreads far more rapidly to other areas than up to the present time we have fully realized. Nevertheless, at first it is a local disease and therefore amenable to local attack in its early stages. I venture to express the belief that ultimately a more complete radiation of the chest areas will be routinely practiced in the effort to forestall and check any possible early involvement in these regions. The problem of such a program is not devoid of many practical difficulties, for normal intervening



FIG. 3.—Case No. 53, A. R. March 17, 1920, before radiation.

tissues are also extensively radiated and the patient's general resistance may be seriously lowered with marked anæmia and aggravated digestive disturbances following a prolonged radiation; therefore any effort to completely radiate the chest and mediastinum must take into account the patient's general strength and her reaction to radiotherapy.

B. What may we learn from the patient?

The clinical pathological data being developed in the institution will ultimately throw much light upon this problem. Statistics are always uninteresting and frequently misleading, but there are a few facts concerning the group under report which I will briefly touch upon. The complete list of cases appended contains additional data.

## RADIATION OF CARCINOMA OF THE BREAST

*Age.*—The age of the patients varied from twenty-two to eighty-four years, the average being fifty-four.

Between the ages of 21 to 30.....	2 patients
Between the ages of 31 to 40.....	11 patients
Between the ages of 41 to 50.....	22 patients
Between the ages of 51 to 60.....	28 patients
Between the ages of 61 to 70.....	11 patients
Between the ages of 71 to 84.....	7 patients

(In two patients, no age was mentioned.)

*Trauma.*—As a possible etiological factor, fairly definite trauma was present in twenty-four of the eighty-three cases, or 28.9 per cent.

*Lactation.*—Thirty-five of the patients had never had a lactating breast, giving a percentage of 42.2 per cent. Approximately one-third of the patients



FIG. 4.—No. 53, A. R. April, 1920, present condition: there is still considerable tumefaction underlying the area of retraction.

presenting themselves at the hospital with breast carcinoma have never had a lactating breast.

*Pathology.*—Whenever it is possible, a section of the tumor tissue is secured. We are succeeding more regularly in this effort in the past two years than in the years 1918 and 1919, there being pathological reports upon thirty-four of the eighty-three patients, six upon very advanced cases and twenty-six out of the fifty-seven patients considered suitable for treatment. Of the thirty-three cases in which pathological examinations were made, eight showed fibrocarcinoma, twelve carcinoma simplex, nine alveolar carcinoma, four infiltrating carcinoma, and one plexiform carcinoma. In five instances the tumor was believed to have a sweat-gland origin rather than

one from breast tissue itself. We hope later to develop some data upon the behavior of these so-called sweat-gland carcinomas of the breast, but at the present time have nothing to offer.

The primary inoperable carcinoma has usually gone into the infiltrating stage whatever the primary type of tumor may have been. In fact, if one searches diligently throughout the whole tumor one may find varied types of carcinoma, perhaps in one section fibrocarcinomatous elements and in another area a more markedly cellular appearance. Early in the disease certain anatomical types may be expected to run a certain clinical course. An encapsulated adenocarcinoma, which later goes on to a fungating stage, runs



FIG. 5.—Case No. 56, M. S. January 24, 1921, large fixed inoperable tumor of the right breast.

an entirely different clinical course than a hard fibrocarcinoma of an older woman or a diffuse, markedly cellular, carcinoma in a young woman. However, when the disease has become more fully developed, a histological study of a single specimen removed from a breast cancer may give very little information to the surgeon concerning the probable clinical course of the disease from that time on. Nevertheless, it is advantageous that pathological data be obtained whenever it is possible.

*Treatment by Radiation.*—Frequent visits to the breast follow-up clinics make it possible to obtain accurate data upon the progress or regression of the disease. A weight record gives a very fair index of the patient's state of health, though we have observed in many instances an advance of the malignant process with no loss of weight or obvious impairment of the health. Upon the other hand, when a case of inoperable breast cancer begins to lose weight rapidly, we realize that not many months will elapse before the

patient will succumb to the disease. In his study of the treatment of breast carcinoma by radiation, the writer wishes to gratefully acknowledge the hearty coöperation given to him by Doctor Herendeen, the röntgenologist at the Memorial Hospital.

*Treatment by X-ray.*—If the growth is one of considerable size, we usually rely upon X-ray radiation. This is given in cycles of four or five treatments per cycle, at intervals of one, two, or three days between treatments. The breast, anterior chest-wall, lateral chest-wall, axillary and supraclavicular regions are covered by this radiation. The usual dosage with a ten-inch spark-gap is fifteen minutes of treatment, using a ten-inch focal distance,



FIG. 6.—Case No. 56, M. S. April, 1922, present condition; nodes in the right axilla are now not palpable. Patient has gained twenty-two pounds.

four milliamperes of current, and four millimetres of aluminum filtration. This gives the average patient a very definite erythema of the skin, but no blistering. There is, however, a wide variation in susceptibility to radiation, and, while some stand a larger amount of radiation than others without damage to the skin, in general the dosage outlined is a safe one to use. The danger of overradiation by X-ray must always be borne in mind. It is far better to be satisfied with a reasonable result than to attempt the impossible. Marked telangiectases developing in the skin should be considered a contra-indication to further treatment by radiation. If this precaution is not observed ulceration will often ensue with, at times, a development of an epithelioma. There is no instance in this report of any patient developing epithelioma from overradiation.

If the tumor tissue is quite superficial, or there are numerous subcu-

taneous nodules, or there is a diffuse pseudoinflammatory involvement of the skin by the new growth, X-ray for a shorter period, giving a more superficial dosage, yields the best results. There have been some remarkable disappearances of skin nodules and carcinomatous skin involvement by this means. As a rule the whole side is radiated, including the supraclavicular and axillary regions. An interval of five or six weeks is allowed to elapse before the second cycle of treatment is undertaken, and in the meanwhile the patient is seen several times that the reaction to radiation may be observed.

As a rule the effect upon the breast tumor or upon axillary or supraclavicular nodes from this type of radiation is a distinct diminution in size



FIG. 7.—Case No. 77, W. L. June 9, 1920, before X-ray radiation. A very advanced, rapidly growing cancer of the left breast.

appreciable in from three to seven weeks. If after two or three such cycles there seems to be no further advance in the disease, it is wiser to defer radiation for a period, the patient meanwhile being kept under observation.

We are convinced that unless the radiation causes a considerable erythema of the skin, the underlying mass does not receive sufficient radiation to properly affect the carcinomatous cells. Systematic treatment of chest metastases has not yet been undertaken at the hospital, but we are hoping that something may be accomplished with our new high-powered machine now in operation, giving 200,000 peak voltage through the tube with a spark-gap of 14 inches. One cannot, however, forget when one is radiating carcinoma deep within the chest cavity, that everything between that point and the source of radiation is also being heavily radiated, furnishing a serious obstacle to effective radiation of the tumor.



## RADIATION OF CARCINOMA OF THE BREAST

*Treatment by Radium.*—The type of cases best suited to radiation by means of radium are small breast tumors with involvement of axillary and supraclavicular nodes and tumors involving the sternum and chest-wall to a moderate degree. With the small breast tumor, after complete X-ray radiation, the insertion of radium bare-tubes, using one mc. per cubic centimetre of breast tumor, gives very satisfactory results. This insertion of bare-tubes is done under novocaine anaesthesia. The tubes are introduced through needle canulae, the little glass tube containing the radium emanation being forced into the breast tumor at any desired point by pressing a minute plunger in the needle. This must be done in a very systematic fashion, and one must



FIG. 8.—Case No. 77, N. L. Same case as in Figure 7. July 30, 1920, after X-ray radiation, showing marked local effects from radiation.

be reasonably certain that all parts of the tumor have received an adequate insertion of radium. The same method may be employed in the axillary region if the nodes are not closely adjacent to the brachial plexus or not too deeply placed in an inaccessible position. One may introduce these tubes to within a distance of one centimetre from the nerves, but closer introduction will cause an intractable case of neuritis. The bare-tubes containing the radium introduced through the skin or through a minute incision, which also permits the removal of a section, must never be placed nearer than one centimetre from the outer surface of the skin, or ulceration will ensue. The treatment by bare-tubes has given us some excellent results, with complete disappearance of the tissues in some instances, over a period of two years up to the present writing.

Upon the other hand, a case which has received extensive external

radiation by X-ray or radium, with beginning areas of telangiectasis, is a poor one in which to insert radium bare-tubes, as the tissue vitality is poor and ulceration may ensue. In a tumor a little larger, say four centimetres in diameter and upwards, we frequently make use of a platinum needle carrying 50 to 70 mc. of radium gas, contained in glass tubes, the platinum needle having a thickness of .4 of a millimetre. This is introduced through the skin into the tumor and is allowed to remain there until the new growth receives approximately 50 mc. hours of treatment for each cubic centimetre of tumor tissue. The needle is partially withdrawn at fixed intervals,

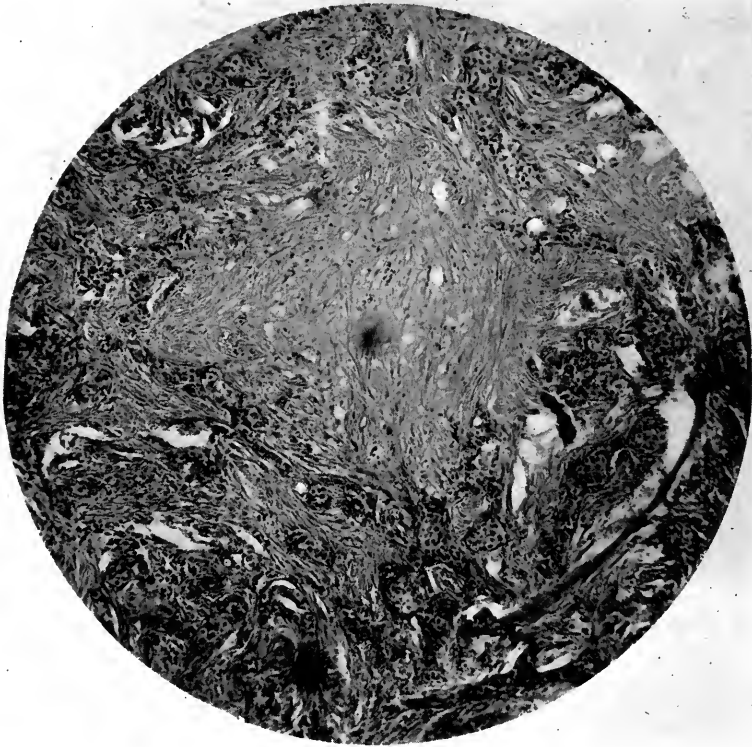


FIG. 9.—Low-power, showing radiation effects on a cancer of the breast.

permitting radiation of additional parts of the tumor. We have had some excellent regressions by this method, and in one instance an entire disappearance of the tumor. A sufficient time, however, has not elapsed to determine whether or not there may be a reappearance of the carcinomatous mass.

External radiation by means of a radium pack, using 8500 to 9000 mc. hours for 70 square centimetres of surface, at a distance of 6 cubic centimetres from the skin, with a filtration of  $\frac{1}{2}$  millimetre of silver and 2 millimetres of brass, gives frequently an excellent regression in a small, well-localized tumor of the breast, sternum, or chest-wall, and axillary

## RADIATION OF CARCINOMA OF THE BREAST

nodes are also treated by a similar pack placed over the base and anterior aspect of the axilla. The supraclavicular region is best radiated by means of the brass tray containing radium emanation, if the nodes are superficial, the distance from the skin being 3 centimetres, with a filtration similar to that of the pack, giving 2500 to 3000 mc. hours of treatment. If the nodes are extensively involved or more deeply placed, the pack is preferable. External radiation with radium may be repeated at a like interval to the Röntgen-ray treatments, and patients are followed in the meantime to determine the exact response to radiation.

*Pathological Changes from Radiation.*—Aside from the clinical evidence of marked diminution in size or even complete disappearance of a tumor

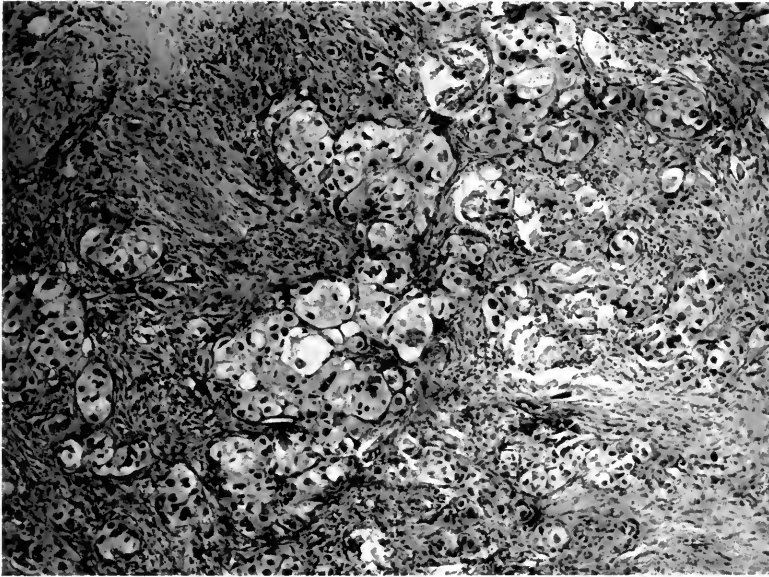


FIG. 10.—High-power, showing radiation effects upon cancer of the breast.

by radiation, there are also macroscopical and microscopical changes. Macroscopically small areas of necrosis may be seen for a distance of one centimetre in all directions from the point of insertion of radium bare-tubes, and the same type of gross necrosis may be evidenced following external radiation. The microscopical effects following treatment by radium and X-ray may be very marked, consisting of hyperchromatism of the nuclei, hydropic degeneration of the cytoplasm of the cell, and a granular degeneration of the connective-tissue stroma surrounding the carcinomatous cells. Ultimately the tumor cells may disappear and nothing but a granular detritus remain. Frequently, well-marked endarthritis may be observed in the blood-vessels within the radiated area. Eventually the fully radiated areas are reduced to hard fibrous cicatricial tissue.

*Duration of Life.*—We have found such a startling difference in the life-

history of these cases that at times it almost seems as if the rapid and slow cases must be different diseases. One patient presenting herself at the clinic had never been operated upon and had never been treated, but had lived for twenty-two years with a carcinoma *en cuirasse* covering a large part of the anterior chest-wall. She eventually succumbed to the disease. (No. 83.) At the moment we doubt the wisdom of attempting to draw any conclusion as to the prolongation of life in a case of inoperable carcinoma of the breast treated by radiation. Few figures upon this subject can be obtained. Lazarus Barlow has stated as far back as 1904 and 1905 that the average life of untreated carcinoma or unoperated carcinoma of the breast was 38.5 months.

The total duration of life of patients in this report is as follows:

In the very advanced group (of 26) we found that the duration before treatment averaged two years, 5.8 months, with a maximum duration for one patient of 22 years and a minimum duration of two weeks. The duration after admission to the hospital averaged approximately four months,

#### I. *Doing badly*

No.	Initial	Duration After Treatment
5	E.M.	3 years, 8 months
8	A.T.	3 years, 5 months
18	A.H.	2 years, 9 months
23	M.K.	3 years
29	M.B.	15 months (data incomplete)
28	A.B.	1 year, 6 months
31	C.D.	2 years, 3 months
41	C.M.	13 months (data incomplete)
43	M.M.	2 years, 2 months
48	M.O.	1 year, 7 months
51	A.H.	15 months (data incomplete)
55	L.G.	1 year (data incomplete)

#### II. *Doing well*

No.	Initial	Duration After Treatment
9	L.N.	4 years
25	A.S.	2 years, 9 months
26	E.T.	3 years, 5 months
30	M.C.	1 year, 7 months
32	M.D.	1 year, 6 months
33	E.A.	1 year, 5 months
35	T.C.	1 year, 5 months
36	A.F.	1 year, 11 months
44	S.M.	1 year, 10 months
46	M.M.	1 year, 10 months
47	M.N.	2 years, 5 months
53	A.R.	2 years, 1 month
56	M.S.	1 year, 8 months

## RADIATION OF CARCINOMA OF THE BREAST

with a maximum duration of one year, and a minimum duration of two weeks. The average total duration of life for the very advanced cases was two years, 9.2 months. Maximum duration: 22 years, 5 months; minimum, nine weeks.

In cases which seemed suitable for treatment we found that the average duration before treatment was two years, four months, the longest duration in one case being eighteen years, the shortest one month. The duration of life after admission gave an average of one year, seven and a half months, the longest duration being four years, and the shortest two months. The average total duration of life in these 57 cases was four years and three-tenths of one month, the longest case giving a duration of nineteen years and eight months, and the shortest one year, two months. As one may readily see, the average duration in the 57 cases favorable for treatment was almost a year longer than the figure of 38.5 months quoted from Barlow.

Finally, as to the living and the dead. At the present writing all of the 26 advanced cases are dead and the details concerning them will be found in the tabulated report which accompanies the written text.

Of the 57 cases which seemed worthy of treatment, 25 are to-day alive and 13 of them are doing well. The tabulated results of the 25 cases is appended in order that the data may be more readily available.

Average duration of life after treatment of those doing well is two years, 3.1 months, the longest duration since treatment being four years, the shortest one year and five months.

### CONCLUSIONS

In conclusion the following points should be emphasized:

1. Primary inoperable carcinoma of the breast has shown good results by radiation.
2. The patient must be kept under constant clinical observation.
3. The type of radiation must be properly selected for each individual case. No routine prescription will suffice.
4. Overtreatment by radiation must be avoided.
5. Very advanced cases are unsuitable for any form of treatment.
6. The palliative operation following properly planned radiation is of service in well-selected cases.
7. A coöperating Social Service Department makes a follow-up system effective and gives humanitarian relief to the hopeless cases.
8. The results to date are very gratifying and encouraging. As the disease itself and the technic of radiation become better understood, we believe that more and more satisfactory results will follow, and that the possibility of still further control of the disease by radiation may ultimately be realized.

## DIGEST OF CASES OF PRIMARY INOPERABLE

No.	Name	Age	MSW	Lact	Trauma	Date first symptom	First symptom	Date of admission	Condition on admission
1	R. C. .... (Quick)	45	M	?	None	Aug. 16	Eczema of nipple	Aug. 18	Left breast upper outer quadrant. Mass 3x5 cm. Axillary and supraclavicular nodes. Breast mass reddened.
2	S. G. .... (Quick)	54	M	0	Corset pressure	Aug. 18	Pain, shortly followed by redness near nipple	July 18	Left breast <i>en cuirasse</i> . One-third of breast surface red and hard. Axillary nodes. Supraclavicular?
3	M. L. .... (Quick)	58	M	2	None	July 15	Mass outer lower quadrant right breast	July 18	Right breast, multiple nodules in breast. Axillary and both supraclaviculars. Right suprac., skin fixed over it.
4	B. L. .... (Janeway)	39	M	2	None	Oct. 17	Mass in left breast and pains	Apr. 18	Tumor just above nipple, left breast, 3x2 cm. Axillary and supraclavicular nodes.
5	E. M. .... (Stone and Lee)	51	W	0	Yes	Sept. 15	Small movable lump right br.	July 18	Large hard tumor right breast, 10x11 cm. Fixed to muscle. Axillary and supraclavicular nodes.
6	K. M. .... (Janeway)	60	M	0	0	Dec. 17	Small lump, right breast	Aug. 18	Tail right breast ulcerated. Hard axillary nodes. Small supraclavicular nodes. Arm swollen.
7	M. H. P. .... (Coley)	43	S	0	None	Sept. 15	Hard lump, lower inner quadrant right breast	Sept. 18	Right breast, central position, hard nodular size of orange. Attached to muscles. No nodes.
8	A. T. .... (Quick)	65	M	0	Yes	Nov. 14	Small lump, right breast. Later painful	Nov. 18	Right breast shrunken hard, adherent to underlying structures. Discolored. Ulceration about nipple. Axillary nodes.
9	L. N. ....	55	M		Yes	Apr. 9	Swelling near tail of breast and axilla	Apr. 17	Large ulcerated tumor, involving upper inner quadrant left breast. Some axillary nodes.
10	F. B. .... (Quick)	60	M	13	None	Jan. 18	Red inflamed, left breast	Jan. 19	Whole left breast 20x24 cm. <i>en cuirasse</i> . Very red, fixed to deeper structures. Axillary nodes?
11	M. B. .... (Janeway and Lee)	45	M	2	Yes	June 18	Small lump, left breast	Oct. 19	Left breast hard, infiltrating, fibrosed. Red, almost ulcerating. Fixed to muscle. Large axillary nodes. Small supraclavicular nodes.
12	E. B. .... (Quick and Lee)	62	W	3	None	Aug. 11	Small hard lump, left breast	Aug. 19	Left breast, outer quadrant, cauliflower ulcerated growth 5x7 cm. Ulceration extends into axilla. Also axillary nodes.
13	M. C. .... (Janeway)	84	W	8	Yes (?)	Apr. 19	Small lump, left breast	Oct. 19	Above left nipple indurated mass 6x4 cm., ulcerating in centre. Large hard axillary nodes.
14	L. C. .... (Quick)	56	M	1	None	Sept. 16	Nodule outer upper edge right nipple	Sept. 19	Nodule, upper outer part, right breast, fixed to deeper parts. Axillary nodes.
15	G. E. .... (Quick and Lee)	34	M	1	None	Jan. 18	Small lump upper inner quadrant right breast	Mar. 19	Whole right breast involved in tumor process. Few nodes in axilla, adherent to mass 3 cm. right side of sternum

# RADIATION OF CARCINOMA OF THE BREAST

## CARCINOMA OF THE BREAST, TREATED 1918-1919

Path. type	Treatment	Result of treatment	Course	Duration before admission	Duration after admission	Total duration with result
Fibrocarcinoma No. 3835	X-ray		Rapidly, worse locally	2 yrs.	14 mo.	3 yrs. 2 mo. Died
	X-ray		Later developed metastases of spine	3 mo.	1 yr.	1 yr. 3 mo. Died
	X-ray		Progressively worse	3 yrs.	19 mo.	4 yrs. 9 mo. Died
	Radium, X-ray	Regression in size of mass		7 mo.	1 yr. 8 mo.	2 yrs. 3 mo. Died
	Radium (bare-tubes pack), X-ray	Very marked local regression for two yrs. after admission. Later breast ulcer. Local palliative removal, skin-graft	Past year skin recurrences and left breast involved with progression of disease	3 yrs.	3 yrs. 8 mo.	6 yrs. 8 mo. Patient in Home for Incurables. Alive
	Radium (bare-tubes to breast tumor and axilla)	Some regression	Rapid	10 mo.	10 mo.	1 yr. 8 mo. Died
	Radium (bare-tubes for breast) X-ray	Diminution in size of growth	Slow progression of symptoms. Chest metastases	3 yrs.	3 yrs. 6 mo.	6½ yrs. Died
	Radium (pack) X-ray	Some diminution in size of tumor	Last yr. gradual failure in health	4 yrs.	3 yrs. 5 mo.	7 yrs. 5 mo. Alive, but bed-ridden in Home for Incurables
	Palliative operation, by Dr. Bolling. Radium, X-ray	Recurrence, near scar, 1 or 2 in about 3 yrs. Later supraclavicular node, right ax. node. Small mass over scapula	Doing well in spite of dissemination. No loss of weight	8 yrs.	4 yrs.	12 yrs. doing well in spite of dissemination
Ca. simplex, probably sweat-gland ca. No. 2428	X-ray		Developed metastases fourth and fifth lumbar vertebrae	1 yr.	9 mo.	1 yr., 9 mo. Died
	Radium (bare-tubes in breast tumor)	Primary regression	Ulceration extended, swollen arm. Chest metastases. Pagets	16 mo.	7 mo.	23 mo. Died
	X-ray (palliative removal of breast by cautery, Apr. 1920)	Relief from sloughing breast	Disease progressing	8 yrs.	1 yr. 10 mo.	9 yrs., 10 mo. Died
	Radium (externally and bare-tubes in breast)	Very little change		6 mo.	9 mo.	1 yr., 3 mo. Died
Ulcerating fibrocarcinoma No. 2307	Radium (bare-tubes) X-ray			3 yrs.	10 mo.	3 yrs., 10 mo. Died
	Radium (bare-tubes) X-ray	Initial marked diminution in size. Ulceration over upper mass	Slow but progressive	14 mo.	20 mo.	34 mo. Died

## DIGEST OF CASES OF PRIMARY INOPERABLE

No.	Name	Age	MSW	Lact	Trauma	Date first symptom	First symptom	Date of admission	Condition on admission
16	M. F. . . . . (Janeway)	56	S	0	Yes	May 18	Pulling sensation, left breast, and one axillary node. Also mass in breast	May 19	Left breast seat of large mass 12 cm., fixed to deeper structures. Axillary and supraclavicular nodes. Also right axillary. Left arm considerably swollen
17	M. G. . . . . (Lee)	66	W	?	None	Sept. 16	Swollen red breast	Nov. 19	Left breast—firm, hard mass upper outer quadrant. Intraclavicular, firm hard adherent mass. Axillary and supraclavicular nodes
18	A. H. . . . . (Janeway)	41	S	0	None	Jan. 18	Hard lump in right breast	July 19	Right breast entirely occupied by neoplasm firmly adherent to chest wall. Fungating cauliflower mass 8 cm. Axillary nodes
19	A. P. . . . . (Quick)	50	M	0	None	Dec. 18	Mass right breast. Ulceration soon	Apr. 19	Right breast contains rounded mass 5×7 cm. Ulceration fixed to deeper parts. Axillary nodes. Additional skin nodules over breast
20 U. S.	F. H. . . . . (Stone and Lee)	51	M	2	None	Aug. 18	Pimple, size of pea, outer quadrant right breast	Apr. 19	Right breast irreg. nodular mass, 6 cm. diameter. Fixed to deeper parts. Axillary and supraclavicular nodes
21 U. S.	C. M. . . . . (Quick)	42	M	?	None	Apr. 17	Tumor inner side left br., small nodule	Apr. 19	Solid tumor 2½ cm. lower inner quadrant left breast, fixed to chest wall. Few small axillary nodes. One supraclavicular node
22 Ire.	M. M. . . . . (Quick and Lee)	75	W	9	Yes	Aug. 14	Presence of mass in left breast. Later gripping sensation in breast	Aug. 19	Spherical mass, left breast 5×7×7. Many large axillary nodes and supraclavicular
23 Ire.	M. K. . . . . (Stone and Lee)	57	S	0	None	Apr. 14	Retraction left nipple. Ulcerated 2 years later	Apr. 19	Left breast, tumor 4×6. Fixed at deeper parts. Axillary and supraclavicular nodes
24 U. S.	G. P. . . . . (Janeway)	60	S	0	None	Jan. 1. Operation advised but refused at that time	Small skin indentation of left br.	Jan. 19	Left breast, enlarged hard globular mass outer ¼ Red cutaneous nodes. Large nodes in axilla and supraclavicular
25 Italy	A. S. . . . . (Quick and Lee)	65	W	4	None	Jan. 19	Little lump, upper outer quadrant, right breast.	July 19	Right breast, large mass outer lower quadrant 7×7 cm. Markedly inflamed. Several large axillary nodes. Breast mass ulcerating
26 U. S.	E. T. . . . . (Stone)	78	W	2	None	Nov. 18	Small nodule, left anterior axillary fold	Nov. 19	Left breast tail, tumor mass 5×4×2 cm. Slight fixation to deeper parts. Supraclavicular nodes (?). Axillary nodes
27 U. S.	A. Z. . . . . (Stone)	40	M	2	None	Aug. 18	Lump, left breast	Apr. 19	Left breast, hard mass 2×3 cm. Axillary and supraclavicular nodes



# RADIATION OF CARCINOMA OF THE BREAST

## CARCINOMA OF THE BREAST, TREATED 1918-1919

Path. type	Treatment	Result of treatment	Course	Duration up to admis.	Duration after admis.	Total duration with result
Diffuse carcinoma No. 2427	Radium. (Bare-tubes) in nodes in breast, X-ray	Some regression	Rapid (hemorrhage pneumonia)	1 yr.	8 mo.	1 yr., 8 mo. Died. Autopsy: Regressing mammary carcinoma diffuse retroperitoneal neoplasms plus
Solid infiltrating alveolar, car. Edema necrotic areas and hydropic cells suggest X-ray effects. No. 1817 No path.	Palliative, removal br. Dec. 19 and radium into axillary mass. Skin grafting later	Marked neuritis along brachial plexus. No recurrence at site of breast removal	Nov. 20, 2nd lumbar vertebræ metastases. Skin recurrence in scar	3 yrs.	1 yr., 6 mo	4 yrs. 6 mo. Died
	Radium. (Bare-tubes in breast and axillary node.) Tray. X-ray	Very marked local regression	Gen. condition continued good. Ulceration persisted	1½ yrs.	2 yrs., 9 mo.	4 yrs., 3 mo. Still alive—but confined to bed
	X-ray	Progressively worse		4 mo.	1 yr.	1 yr., 4 mo. Died
Specimen removed but lost	Radium. (Bare-tubes for left axilla.) X-ray	Marked regression of breast and axillary tumors	Developed left axillary mass. Later tumor in left breast also. Chest metastases	8 mo.	2 yrs., 6 mo.	3 yrs., 2 mo. Died
	Radium (pack)	Breast mass more movable, diminished in size. Axillary nodes smaller		2 yrs.	1 yr., 2 mo.	3 yrs., 2 mo.
	X-ray	Initial regression of breast, tumor and also breast mass became movable	Patient did fairly well for year and half. Then became poorer	4 yrs.	1 yr., 11 mo.	5 yrs., 11 mo. Died
	X-ray. Radium (bare-tubes in breast pectoral fold)	Considerable regression in breast mass 2 yrs. after beginning treatment; 13 skin recurrences around breast. About same time suspicious evidence of chest metastases	Ulcerating small area, appeared later over site of skin adherence. Coughing considerably. Presumably due to chest metastases	5 yrs.	3 yrs.	8 yrs. Still alive, though confined at home under Social Service care
	Radium (pack) (bare-tubes)		Developed spinal metastases	18 yrs.	1 yr., 8 mo.	19 yrs., 8 mo. Died
	X-ray Radium. (Bare-tubes right ax.) Palliative amputation. Skin grafting	No advance in axillary process. No other evidence of disease	Skin very bronzed from radiation. No radiation since operation	6 mo.	2 yrs., 9 mo	3 yrs., 3 mo. Still alive, doing very well. Weight on admission 105 lbs. Present weight 120 lbs.
	External application radium over breast. X-ray	Local regression tumor mass	Ulceration developed later. Chest signs suggest metastases	1 yr.	2 yrs., 5 mo	3 yrs., 5 mo. Still alive
	Radium. (Bare-tubes). X-ray	Local regression in breast and nodes	8 mo. 11 mo.	1 yr.	7 mo.	Died

## DIGEST OF CASES OF PRIMARY INOPERABLE

No.	Name	Age	MSW	Lact	Trauma	Date first symptom	First symptom	Date of admission	Condition on admission
28 Eng.	A. B. .... (Lee)	48	S	0	0	July 18	Sharp pain right breast. Soon entire breast became hard	Oct. 20	Right breast large tumor 5x3 cm. Definite axillary nodes. Suprac nodes (?)
29	M. F. B. .... (Stone)	?	M	2	0	June 18	Tightening in left breast, near axilla. 4 mo. decided dimpling of skin in this area. Tumor	June 20	Tail left breast movable mass skin adherent, left arm swollen, suprac. nodes
30 U. S.	A. C. .... (Quick)	40	S	0	0	Apr. 20	Left breast little larger than normal. Discovered hard mass in it. Slight fixation, deeper structures	Sept. 20	Whole left breast involved. Axillary lymph-nodes
31 U. S.	C. De H. .... (Janeway)	54	S	0	Yes	Apr. 13	Small lump size marble, outer quad. right breast. (Excision advised. Refused.)	Jan. 20	Right breast retraction, mass 4x5x2, upper outer quad. Left breast also involved. Ulcerated nodular mass, 4x5x3 cm. Axillary nodes (?)
32 U. S.	M. D. .... (Lee)	53	S	0	0	Oct. 19	Small lump size marble, right breast ulcerated 1 mo. before admission	Oct. 20	Right breast huge, fungating cauliflower mass 10 cm. diameter, elevated 4 cm. Secondary cutaneous nodules. Left breast hard mass above nipple, 6 cm. diameter. Skin fixed. Marked nodes right axilla.
33 Col. U. S.	E. A. .... (Lee)	54	S	0	0	Mar. 18	Small hard lump, size of marble, in left breast	Nov. 20	Middle two-thirds left breast hard irregular mass, with brawny nodules. Fixed to deeper parts. Axillary nodes definitely involved
34 Aus.	A. E. .... (Lee)	73	W	8	0	Dec. 18	Small lump, rt. breast. Ulcerated 9 mo. before admission	Dec. 20	Large ulcerated mass right breast, axillary and suprac. nodes markedly involved, also left axillary nodes
35 Col. U. S.	T. C. .... (Lee)	73	W	1	0	Feb. 19	Small lump right breast, later sticking, burning pain	Dec. 20	Right breast, eczema nipple. In fold beneath breast ulcer, 2x6 cm. Underlying tumor fixed to muscle. Large node right ax. low down. Suprac. (?). Subcutaneous nodule, 3 cm. diameter, upper outer quadrant, right breast. Pagets
36	A. F. .... (Lee)	54	S	0	0	May 18	Nipple retracted. One yr. later small growth near nipple	May 20	Major portion of left breast occupied by irregular hard tumor, 10x8 cm. Nipple markedly retracted. Abrasion below it. Pig-skin appearance, somewhat fixed. Hard, fixed axillary nodes
38 Aus.	B. G. .... (Lee)	42	S	0	0	Apr. 18	Small lump, size egg, left breast	Oct. 20	Left breast nipple missing. Ulcerated area 8 cm. diameter underlying nipple site with tumor mass beneath it. Markedly inflammatory. Adherent cutaneous masses in axill. Whole arm swollen

# RADIATION OF CARCINOMA OF THE BREAST

## CARCINOMA OF THE BREAST, TREATED 1918-1920

Path. type	Treatment	Result of treatment	Course	Duration up to admis.	Duration after admis.	Total duration with result
	X-ray	Mass definitely smaller. Axillary nodes disappeared Nov. 21. Small nodule in skin midway between nipple and axilla	This nodule developed 16 mos. after beginning treatment. Chest plate suggests ca. metastases	2 yrs., 3 mo.	1 yr., 6 mo.	3 yrs., 9 mo. Still alive, but in fair general condition
	Radium pack. Radium trays. X-ray	Local regression tumor in tail of breast markedly contracting	Later node developed in neck. Left axillary node small and movable	2 yrs.		
	Radium. pack. (Bare-tubes)	Regression of breast tumor	Right suprac. nodes present. Right breast involved, Oct. 21	5 mo.	1 yr., 7 mo.	2 yrs. Still alive, with disease held well in check
	Radium (Bare-tubes.) Radium pack, X-ray	Marked regression in size of breast. Pain diminished	Left arm became swollen Mar. 22, pt. being cared for at home	8 yrs., 9 mo.	2 yrs., 3 mo.	11 yrs. Still alive but not doing well
Infiltrating carcinoma. No. 3345	X-ray. Radium externally, palliative removal of breast, Dec. 20. Last X-ray Dec. 21. Skin grafted later	X-ray treatment of ulcerating right breast, diminished breast but not ulceration. Left breast size diminished	Feb. 19, 1922. Good general condition. Weighed 131 lbs. (On admission 120 lbs.) Few skin recurrences. Left breast no larger. Axillary nodes still present	1 yr.	1 yr., 6 mo.	2 yrs., 6 mo. Still alive, good general condition
Carcinoma simplex	Radium pack, X-ray	Breast tumor became more movable and diminished in size with less skin involvement	Nodes in both axillae	2 yrs., 8 mo.	1 yr., 5 mo.	4 yrs., 1 mo. Still alive, feeling well
Carcinoma simplex No. 3597	X-ray	Very little result noted from X-ray treatment, arm swollen	Disease held in check for short time; then steady advance of disease	3 yrs.	16 mo.	4 yrs., 4 mo. Died
Fibrocarcinoma invading epithelioma of skin. No. 3256	X-ray	Ulcerated area much smaller. Breast mass smaller	Patient in excellent general condition. No increase local disease. Chest negative	22 mo.	17 mo.	3 yrs., 3 mo. Alive, feeling very well
Alveolar carcinoma, probably sweat-gland type, very cellular No. 3913 No. 2534	Radium B.T., Pack, X-ray. Palliative removal ulcerated breast under novocaine	Ulceration of skin over breast Diminution in size of breast. No increase in size of nodes	Patient has continued to do well. Chronic nephritis with high tension	2 yrs.	1 yr., 11 mo.	3 yrs., 11 mo. Alive, doing well
Small alveolar carcinoma probably duct type. No. 3025	X-ray	Local regression of tumor	One yr. after treatment evidence involvement left pleura	2½ yrs.	1 yr., 5 mo.	3 yrs., 11 mo. Died

## DIGEST OF CASES OF PRIMARY INOPERABLE

No.	Name	Age	MSW	Lact	Trauma	Date first symptom	First symptom	Date of admission	Condition on admission
39 Rus.	L. H. .... (Lee)	70	W	7	Yes	Mar. 19	Small lump, right breast	July 20	Marked enlargement whole right breast. Diffuse blushing of skin lower half. Tumor adherent chest wall
40 Aus.	G. H. .... (Lee)	55	M	5	o	1897 Dec. 19, began to increase in size	Small lump, size hazelnut left breast	Feb. 20	Nearly whole left br. seat of tumor. Fixed at deeper parts. Large axillary mass nodes, fixed. General condition good
41 Ire.	C. M. .... (Lee)	43	M	o	o	May 13	Lump, size egg, outer side, left breast	May 20	Hard mass, running from left nipple outward, 5 cm. One large hard movable node in axilla. Over middle of sternum fixed hard mass 13 cm. long, 5 cm. wide, raised 3 cm.
42 Ire.	A. McC. .... (Lee)	47	S	o	o	Mar. 10	Small lump, left breast	Mar. 20	Large, hard tumor lower part left breast 5x6 cm. Adherent chest wall. Redness. Axillary nodes marked. Supraclavicular nodes
43 U.S.	L. McG. .... (Lee)	51	S	o	o	Feb. 19	Swelling in left axilla	Feb. 20	Whole left breast diffusely infiltrated with tumor condition giving hard large massive breast fixed to chest. Ax. and 3 suprac. nodes
44 Rus. Jew	S. M. ....	52	W	7	Yes	July 18	Small lump size bean in right breast after trauma	July 20	Mass medial section of breast above nipple 2x3x3 cm. One hard node in axillary region, one in suprac. Weight 110 lbs.
45 Ire.	M. M. .... (Lee)	38	M	4	No	Jan. 20	Small lump, size walnut outer portion right breast	Apr. 20	Whole right breast involved with tumor mass 10x7x2. Large hard axillary nodes, several suprac. nodes
46 Italy	M. M. .... (Lee)	43	M	9	o	Apr. 19	Small lump (hazelnut) right breast	July 20	To right and above right nipple a regular ulcer 2x4 cm. Surrounding skin inflamed tender, underlying induration. Large nodes both axillæ. One suprac.
47 Ire.	M. N. .... (Lee)	60	S	o	o	Dec. 16	Small lump right breast	Nov. 20	Right breast lateral to nipple dense and fibrous in skin and involving breast tissue beneath. Adherent to muscle. One node right axilla. Also nodes right supraclavicular
48 U.S.	M. O'C. .... (Lee)	58	S	o	Yes	Sept. 18	Following trauma left breast scarlet. Shortly after left nipple retracted and red	Sept. 20	Primary in left breast (?) Both breasts swollen oedematous. No definite tumors can be felt except firm tissue beneath nipple. Entire chest and upper abdomen covered by reddened, thickened <i>en cuirasse</i> . Left supraclavicular
49	M. R. .... (Stone, Lee)	48	S	o	Yes	Dec. 18	Left breast began to get hard and swollen	July 20	Entire left breast hard and indurated. Nipple ulcerated. Surrounding skin like orange peel. Mass fixed. Large axillary nodes. Some subrac.

# RADIATION OF CARCINOMA OF THE BREAST

## CARCINOMA OF THE BREAST, TREATED 1918-1920

Path. type	Treatment	Result of treatment	Course	Duration up to admis.	Duration after admis.	Total duration with result
Carcinoma simplex No. 2842	Radium bare-tubes in breast tumor	Local regression	Rapid as was expected from blushing of skin. Later involvement right pleura	1 yr., 3 mo.	8 mo.	1 yr., 11 mo. Died.
Carcinoma simplex No. 3313 No. 3465	Radium packs, X-ray. Later breast removed by Strobell method	Initial marked diminution size of tumor. Later rapid growth with cutaneous metastases and ulceration	Toward end very rapidly progressing	6 wks.	16 mo.	17½ mo. Died June 22, 1921
Small alveolar duct carcinoma No. 2487	Radium tray. Bare-tubes in axillary, mass and breast tumor X-ray		Case difficult to follow	7 yrs.	13 mo	Last available note June 21. Patient in fair shape then. 8 yrs., 1 mo., plus
Cellular carcinoma. No. 3582 Fibrocarcinoma, probably sweat-glands No. 2346	Radium pack. Bare-tubes in breast and axillary X-ray	Immediate result satisfactory regression	Slow progression of disease	2 yrs.	2 yrs.	4 yrs. Died Mar. 6, 1922
Fibrocarcinoma No. 2296	Radium pack. Radium B.T. X-ray	Marked regression in size of tumor	Excellent condition for 1 yr., 3 mo. Rapid progression of symptoms after that time. Extensive ulceration of breast	1 yr.	2 mo.	1 yr., 2 mo. Still alive, confined to bed at home. Last note Apr. 10, 1922
Carcinoma simplex No. 2344. From breast	Radium packs, Radium trays, Radium bare-tubes. In breast and axilla. X-ray—last treatment Feb. 21, 1922	Tumor in breast has disappeared. Nodes still present in axilla	Excellent. No advance of disease. Now weighs 143 lbs. Gained 33 lbs.	2 yrs.	22 mo.	3 yrs., 10 mo. Still alive
Carcinoma simplex No. 4572	X-ray	Local regression from tumor mass	Left breast later involved. Abdominal metastases	3 mo.	16 mo.	1 yr., 7 mo. Died Aug. 17, 1921
	X-ray palliative removal breast by outside surgeon		No progression of disease	15 mo.	22 mo	3 yrs., 1 mo., Patient doing very well with no apparent advance of disease
Carcinoma simplex No. 3710	Radium back, Radium trays, Radium bare-tubes Platinum needles. X-ray	Marked local regression for little over year. Ulceration Feb. 22, following Bare-tubes	Slow, Probable mediastinal metastases. General condition still fair	4 yrs.	2 yrs., 5 mo.	6 yrs., 5 mo. Still alive, general condition fair. Small ulcerated area over breast. Daily dressings
Carcinoma simplex No. 2976	X-ray	Almost complete disappearance of red induration in skin. Breasts markedly regressing in size	Broke left femur Sept. 21. Cannot obtain evidence as to presence of metastases	2 yrs.	1 yr., 7 mo.	3 yrs., 7 mo. Still alive. Doing fairly well. Last note March 3, 1922
Fibrocarcinoma sweat-gland type (?)	X-ray	Marked contraction size of breast	Later ulceration—right breast later involved	7 mo.	18 mo.	2 yrs., 1 mo. Died Jan. 20, 1922

## DIGEST OF CASES OF PRIMARY INOPERABLE

No.	Name	Age	MSW	Lact	Trauma	Date first symptom	First symptom	Date of admission	Condition on admission
50 U.S.	M. W. .... (Lee)	53	S	0	Yes	July 19	Small lump right breast	Mar. 20	Upper inner quadrant right breast, completely filled with firm tumor 10 cm. diameter. Mass is fixed. Numerous skin nodules. Axillary nodes
51 Ger.	A. H. .... (Lee)	55	M	4	Yes, indefinite history	Sept. 19	Small mass size of pea rt. breast. Ulceration 5 wks. before admission	Sept. 20	Right breast larger tumor, inner half. Deep crater-like ulceration. Axillary nodes moderately large. Few suprac.
52 U.S.	A. O'N. .... (Lee)	52	M	0	0	Jan. 20	Small lump, size bean, left breast	Sept. 20	Left breast large tumor 18 cm. diameter. Ulceration 12 cm. fungating mass. Large left ax. nodes and supraclavicular nodes. Pt. anemic and emaciated
53 U.S.	A. R. .... (Lee)	65	W	0	0	Feb. 19	Small lump, right br. to outer side of nipple. Size of marble	Mar. 20	Almost entire right breast infiltrated by diffuse hard mass which began close to nipple. Markedly fixed to deeper structures. Extends toward axilla. Infiltration axillary and suprac. nodes on right. Right arm swollen 2½ cm. diameter over left
54 Ire.	A. H. .... (Lee)	50	S	0	0	Aug. 18	Small growth left breast near axilla. Increase in size began 1 yr. later	Feb. 20	Upper outer quadrant, left breast involved in to hard tumor, running into tail. Mass fixed. Nodes both axillæ. Slight ulceration
55 U.S.	L. G. .... (Stone)	47	M	3	Yes	July 13	Following trauma, noticed small lump right breast	June 20	Right breast has raised nodular neoplastic ulceration, 6 cm. diameter. Nipple destroyed. Hard node rt. axilla. One supraclavicular node
56 Ger.	M. S. .... (Lee)	53	S	0	Yes	Aug. 20	Small lump upper inner quadrant right breast	Aug. 20	Lower inner quadrant right breast mass 10 10 cm. Right axilla, left axilla, and suprac. nodes
57 Bohemia Male	O. K. .... (Stone)	44	M		0	July 19	Noticed mass, size egg, overlying left chest	Mar. 20	Numerous hard red nodules in skin about nipple. Firmly fixed tumor tissue lying about nipple. Enlarged nodes both axillæ and scars
58 U.S.	M. A. .... (Quick)	53	M	6	Yes, 1 yr.	Nov. 17	Presence of lump in tail of breast	Nov. 18	Entire right breast red, almost ulcerating. Both axillæ and suprac. nodes. Cerebral lesion
59 Sweden	H. B. .... (Janeway)	40	M	5	No	Nov. 16	Breast enlarged and hard during lactation	Mar. 18	Right breast large, hard, somewhat fixed. Axillary and supraclavicular nodes. Chest plate suggestive. Positive?
60 U.S.	K. C. .... (Quick)	42	M	?	No	6 mo.	Breast red, hard, and swollen	Nov. 18	Whole left breast very large and red. Large nodes in axillary and supraclavicular regions
61 U.S.	E. F. .... (Quick)	?	W	?	?	?		Aug. 18	Tumor upper outer quadrant left breast. Axillary nodes ulcerated. Supraclavicular nodes, 3rd lumbar vertebra

# RADIATION OF CARCINOMA OF THE BREAST

## CARCINOMA OF THE BREAST, TREATED 1918-1920

Path. type	Treatment	Result of treatment	Course	Duration up to admis.	Duration after admis.	Total duration with result
Fibrocarcinoma No. 2212	Radium pack. X-ray	Marked diminution in size breast. Also became more movable. Axillary mass diminished	Axillary mass almost disappeared	9 mo.	8 mo.	1 yr., 5 mo. Died Nov. 20, 1920, at home. Reported by M.D. to be an intrapleural hemorrhage
	X-ray. One cycle	Slight regression size breast tumor	Further follow-up impossible as pt. would not return to hospital	1 yr.	1 yr., 3 mo.	2 yr., 3 mo. Last note Dec. 28, 1921, by Social Service. Pt. under care private physician
Large alveolar ca. Probably sweat-gland type. No. 3054	Radium trays. Radium bare-tubes. X-ray. Oct. 16, 1920. Palliative removal foul ulcerating br. Later grafting		Rapid progression in metastases upper wall of orbit. Pleura in lungs. Later abdominal metastases	8 mo.	9 mo.	1 yr., 5 mo. June 14, 1921
Alveolar carcinoma. No. 2239	Radium pack. Radium trays. Radium bare-tubes. X-ray	Marked diminution in size of breast. Later ulceration, small	Ulceration has diminished considerably. No extension of disease. General condition excellent	13 mo.	25 mo.	3 yrs., 2 mo. Still alive in very good condition. Weight on admission 146. Present weight, 152 lbs.
Carcinoma simplex No. 2345	Radium bare-tubes. X-ray	No advance of disease for about 10 mo. then ulceration	Tumor mass became red and inflammatory Gen. condition failed. Later abdominal metastases	18 mo.	16 mo.	2 yrs., 10 mo. Died June 5, 1921
	Radium externally. X-ray	Some regression in breast and nodes	Ulceration continued. Cerebral Numerous rib metastases. Feb. 21	7 yrs.		Last note, April, 1921. Died
Cellular plexiform carcinoma No. 3704. No. 3561 (axilla)	Radium bare-tubes in breast tumor. X-ray. Palliative removal of breast Skin grafting	Initial, some diminution in tumor but reddened with threatening ulceration. Nodes diminished in size	Gen. condition excellent. No obvious disease. Initial weight 124 lbs. Now weighs 146 lbs.	1 yr.,	1 yr., 8 mo.	1 yr. 18 mo. Alive, splendid condition
Schirrhous carcinoma (Mt. Sinai)	X-ray		Developed chest metastases in both bases	8 mo.	16 mo.	2 yrs. Died July, 1921
	Radium pack X-ray	Some local regression	Steadily downward	1 yr.	9 mo.	1 yr. 9 mo. Died
	Radium pack.	Nothing accomplished generally but definite local regression	Steadily worse	16 mo.	4 mo.	20 mo. Died
	X-ray	Breast diminished redness less marked, mass more movable	Developed chest metastases	6 mo.	5 mo.	11 mo. Died
	Radium pack. X-ray		Rapidly became worse	?	3 mo.	? Died

No.	Name	Age	MSW	Lact	Trauma	Date first symptom	First symptom	Date of admission	Condition on admission
62 U.S.	R. G. ....	35	M	?	o	June 18	Growth upper part left breast	Dec. 18	Both breasts, left ulcerating. All regional glands
63 U.S.	A. L. .... (Janeway)	68	M	5	?	Feb. 18	Discovered small lump left breast	July 18	Left breast large, 10 x 9 cm. hard mass, fixed to muscle. Some axillary nodes. Fluid both chests
64 U.S.	L. McI. .... (Janeway)	66	M	?	Yes, 2 mo.	Sept. 17	Small lump left breast	Dec. 18	Large, ulcerating tumor left breast. Edema of legs. Retention of urine. Spinal metastases
65 Ire.	E. S. .... (Janeway)	48	M	7	Yes	May 17	Tumor in right br. size of walnut	Jan. 18	Entire right breast involved. Mass 16 x 9. Axillary and supraclavicular nodes
66 U.S.	E. C. .... (Quick)	45	M	4	o	Oct. 18	Mass size of egg above nipple, right breast	Apr. 19	Right breast very enlarged, 15 cm. Tumor throughout reddened. Fixed to muscles. Many small nodes in both supraclavicular regions and axillæ
67 Ire.	S. C. .... (Lee)	76	W	?	o	Dec. 17	Small nodule, size of marble, outer quadrant, left breast	Dec. 19	Left breast completely replaced by bluish-purple ulcerated mass-hard. 12 x 14 x 4 cm. Axillary nodes. Also rt. axilla
68 U.S.	M. LaV. .... (Quick)	69	W	5	Yes	Mar. 11	Small spot right breast, site of an old injury. Quite firm, not painful	Mar. 19	Has lost much weight. Cauliflower tumor, right breast, 10 x 7 cm. Very fixed. Large, firm axillary nodes. Hard firm mass in abdomen to left of umbilicus
69 Rus. Jew	A. L. .... (Stone and Bailey)	54	M	o	o	Apr. 19	Hard nodule, 2 x 4 cm., in right axilla. Node removed from right axilla 3 mo. ago by Dr. Berg	July 19	Tumor right breast, 4 cm. Fixed to deeper parts. Axillary nodes. General condition poor. Also adenocarcinoma of uterus
70 U.S.	R. McL. .... (Lee)	31	M	3	o	Dec. 19	Sudden pain in right breast. Nursing baby 7 mo. old. Had refused to nurse for 5½ months	Dec. 19	Pt. jaundiced. Has large liver. Right breast contains tumor, 8 x 7 cm. 2 nodes in axilla
71 Ger.	R. B. .... (Lee)	47	M	7	o	Oct. 19	Small lump, lower part left breast. Ulcerated 2 mo. ago	Aug. 20	Lower outer quadrant, left breast indurated tumor about 6½ cm. diameter. Ulcerated. Left axillary node involved, also supraclavicular. Condition suggests epithelioma
72 Italy	M. B. .... (Lee)	50	M	1	o	Mar. 20	Lump, size of egg, left breast	Sept. 20	Left breast large mass 6 x 7 cm. Nodes in both axillæ and left supraclavicular. Chest metastases
73 Col. U.S.	M. B. .... (Lee)	30	S	o	Yes	July 20	Pain right arm. Shortly after lump, size Eng. walnut, right breast	Oct. 20	Right breast large mass ulcerating 10 x 10 x 10 cm. Large mass axillary node. Supraclavicular nodes (?)
74 U.S.	L. S. C. .... (Lee)	35	W	1	Yes	Feb. 19	Small lump right axilla. Gradually spread toward breast	May 20	Tumor mass right breast above nipple out to axilla 7 x 4 cm. Bluish discoloration. Large hard nodes, axillary. Not fixed. Chest plate carcinoma metastases. Marked anæmia. Left axillary nodes
75 U.S.	D. G. .... (Quick)	60	S	o	o	Sept. 5, Stationery until Sept. 16	Lump, size pea, left breast	Sept. 20	Largestony hard tumor upper outer quadrant, left breast. Freely movable under skin. Hard node left axilla. Metastases 7 and 8 dorsal vertebrae



# RADIATION OF CARCINOMA OF THE BREAST

## CARCINOMA OF THE BREAST, TREATED 1918-1920

Path. type	Treatment	Result of treatment	Course	Duration up to admis.	Duration after admis.	Total duration with result
	X-ray	?	Very rapid	6 mo.	2½ mo.	8½ mo. Died
	Radium bare-tubes. X-ray	Some diminution breast tumor	Progressively worse	5 mo.	5 mo.	10 mo. Died
	Radium pack		Rapidly worse. Irrational	15 mo.	6 wks.	16½ mo. Died
	X-ray		Rapid	8 mo.	2½ mo.	10½ mo. Died
	X-ray		Disease progressive	6 mo.	8 mo.	1 yr. 2 mo. Died
	Never treated		Cared for by social service department	2 yrs.	1 yr. (?)	3 yrs. Probably dead
Very cellular carcinoma No. 1473	X-ray	?	Rapidly worse	8 yrs.	7 mo.	8 yrs. 7 mo. Died
	Radium for uterus. Bare-tubes for breast. X-ray		Rapidly worse	3 mo.	2 mo.	5 mo. Died
Alveolar carcinoma No. 1866	Never treated		Patient grew rapidly worse	2 wks.	7 wks.	9 wks. Died
	X-ray. Two cycles		Steadily downward	10 mo.	5 mo.	1 yr. 3 mo. Died
	X-ray		Nov. 21. Skull metastases	6 mo.	5 mo.	11 months. Died
Malignant partly necrotic tumor. Type uncertain. Very cellular. Grows like epithelioma	X-ray. Palliative removal of foul ulcerating breast by cautery Feb. 5, 1921	Increase of ulceration	Rapidly downward. Fairly clean ulcerated area where breast has been removed	3 mo.	7 mo.	10 mo. Died
Large alveolar carcinoma No. 2482	None		Rapid	15 mo.	2 wks.	15 mo. 2 wks. Died
	Radium packs (breast and spine). Radium bare-tubes for breast. X-ray	Regression in breast tumor	Very rapid	4 yrs.	3 mo.	4 yrs. 3 mo. Died

## DIGEST OF CASES OF PRIMARY INOPERABLE

No.	Name	Age	MSW	Lact	Trauma	Date first symptom	First symptom	Date of admission	Condition on admission
76 Aus. Jew	S. K. .... (Lee)	42	M	6	o Now 7 mo. pregnant	Jan. 20	Lump, size marble, in right breast	May 9,	Right completely occupied by tumor mass, hard, fixed to deeper structures. Breast markedly tender. Slightly inflammatory. No palpable nodes. Metastases left scapular
77 Ger.	W. L. .... (Lee)	42	W	1	o	June 13	Small lump, left breast, size hazel-nut, following weaning of baby. Stationary until 2 mo. ago	June 20	Entire left breast replaced by hard fixed ulcerating tumor extending up to axilla. Numerous hard cutaneous nodules, axillary and suprac. nodes. Pt. looks ill. Temperature 101½. Chest plate not definite carcinoma
78 U.S.	C. L. ....	22	M	0	o	June 20	Small lump, size of marble, left breast, incised by physician 2½ mo. ago	Nov. 20	Left breast markedly swollen, inflamed, ulcerated, adherent to chest wall. Numerous axillary and supraclavicular nodes. Extensive involvement left pleura. No data as to whether at present pregnant. Left arm swollen
79 Ire.	M. McK. .... (Lee)	41	M	2	o	Aug. 20	General enlargement of whole right breast, tumor 10x10x8 cm. Nodes in both axillæ. Also right supraclavicular	Sept. 20	Small node right side neck with skin adherent to it. Also tumor in left breast. Right pleural involvement with fluid. Pt. operated for carcinoma of stomach, March 20
80 Italy	L. M. .... (Lee)	40	M	3	o	Mar. 20	Asthma, 3 mo. later noticed retraction of nipple over upper inner part of breast	Sept. 20	Marked difficulty in breathing. Anæmic. Lost great deal of weight. Left breast large mass 5x18 cm. involving lower portion of breast. Axillary nodes (?) Signs fluids right side chest. (Carcinomatous metastases)
81 Ger.	P. S. .... (Germany)	63	M	5	o	Sept. 20	Shooting pain right breast, 2 mo. later a small lump noticed	Dec. 20	Large mass right breast 12x12cm. Fixed. Surface reddened. Beginning to ulcerate. Both axillary nodes markedly involved. Also supraclavicular, right. Two small subcutaneous nodules
82 U.S.	R. W. .... (Bailey and Lee)	73	W	2		Sept. 13	Slight mass in left breast	Sept. 20	Left breast entirely filled with tumor mass which is inflamed and fixed. Nipple destroyed by ulceration. Axillary supraclavicular and lymph-nodes. Advanced chest metastases left side
83 U.S.	C. A. .... (Lee)	64	W	?	?	1898	Small mass size of pea in the right breast	Mar. 20	Large fungating mass involving whole right anterior chest wall running across somewhat to left side, almost into right axilla. Right arm swollen considerably. Left nipple is seat of ulceration which almost completely hides nipple. Numerous cutaneous nodules over skin right side of back. Considerable mass right supraclavicular region

# RADIATION OF CARCINOMA OF THE BREAST

## CARCINOMA OF THE BREAST, TREATED 1918-1920

Path. type	Treatment	Result of treatment	Course	Duration up to admis.	Duration after admis.	Total duration with result
Carcinoma simplex No. 2564	Radium pack 8064 mc. at 6 cm. inner part breast. Same to outer	Patient did badly from time of radiation	Almost immediately fatal	4 mo.	1 wk.	4 mo. 1 wk. Died May 15, 1920
	X-ray	Marked contraction size of breast	Rapid chest metastases early	9 yr.	3½ mo.	9 yr. 3½ mo. Died Sept. 25, 1920. Autopsy showed metastases into opposite breast and axilla, pleura, lungs, liver, coeliac nodes, bones, and ovaries
	No treatment		Rapid progression	6 mo.	2 wks.	6½ mo. Died Nov. 30, 1920
Fibrocarcinoma No. 2995	X-ray		Rapidly fatal	6 mo.	3 wks.	6 mo. 3 wks. Died Oct. 18, 1920
Section from node above clavicle no carcinoma No. 2975	Radium pack. X-ray	Primary regression	Chest symptoms became rapidly worse. Signs on both sides. Large mass right axilla. Mass section 2nd rib with sternum	6 mo.	6 mo.	1 yr. Died Mar. 16, 1921
	X-ray		Growth tumor very rapid. Mediastinal involvement	3 mo.	2 mo.	5 mo. Died Feb. 21
	X-ray (2 treatments for moral effect on pt.). Radium pack		Rapidly worse	7 yrs.	6 mo. ?	7 yrs. 6 mo. Died at home
Alveolar carcinoma. Probably sweat-gland	No treatment		Most unusual course. Complete history of disease extending over 22 yrs.	22 yrs.	5 mo.	22 yrs. 5 mo. Died at House of Calvary.

## END RESULTS OF OPERATIONS FOR CARCINOMA OF THE RECTUM\*

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AND

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THE technic of operations for malignant disease appeared to be quite definitely standardized many years ago, that is, the growth with a wide margin of healthy tissue was excised en bloc with as large an area as possible of lymphatic drainage. For some reason or other, many surgeons did not apply this technic to carcinoma of the rectum, preferring a local excision of the growth, or an excision of the growth by a very narrow margin, making every effort to leave the sphincter muscle.

Undoubtedly the statistics from Vienna, reported by Hausmann, had considerable influence on the type of operation, for he stated that of one hundred and twelve cases of carcinoma of the intestines which came to autopsy, in fifty-five the disease remained localized in the bowel wall. Undoubtedly the dread of an extensive operation in this region also had some influence, as did also the fact that surgeons were occasionally surprised to find that a patient had unexpectedly lived for ten or twelve years after a local excision. The attitude of surgeons from 1911 to 1920 is best shown by these quotations: Mr. Edwards, before the Royal Medical Society in 1911, said: "My chief object is to enter a protest against the performance of an unnecessarily severe operation with a heavy mortality, in cases attended with little risk to life, and which moreover entail no crippling of the patient." He further says: "I cannot agree with those who advocate the abdomino-perineal method, any more than with those who for a small limited carcinoma of the breast would remove all but the ribs."

Mr. F. T. Paul, in the *British Medical Journal* of 1912, is reported as saying: "Why should we undertake an extensive excision of the mesentery for the removal of glands which in all probability are not infected?"

In spite of the fact that a few surgeons never approved of an extensive operation for carcinoma of the rectum, there has been definite progress toward the more extensive operations, until within the last two or three years, since when there has been a definite backward step. It is very discouraging to read such a statement as that by Mr. Herbert H. Brown, made at the meeting of the British Medical Association in 1920. He said: "But I can assure you that a considerable proportion of the patients upon whom I have operated, generally by the Kraske method, during the past fifteen years, are alive and in good health. I have been much struck by the comparative freedom

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\* Read before the American Surgical Association, May 1, 1922.

from recurrence in cases of cancer of the bowel after operation. I feel it a great advantage to retain the external sphincter if possible."

It is still more discouraging when a man like Lockhart-Mummery states that he has given up the abdomino-perineal operation except in high carcinomata at the recto-sigmoid junction.

Other well-known surgeons have recently recommended local excision or excision followed by end-to-end suture. In other words, there are certain surgeons who still believe that carcinoma of the rectum always, or nearly always, remains localized in the bowel, and therefore an extensive operation is not necessary. This group of men is probably influenced by the occasional case which lives for ten or twelve years after a local excision, and by Hausmann's statistics from Vienna; they certainly could not have looked up the end results of all the cases seen by them. We might very reasonably ask of them what a small limited carcinoma is, which Mr. Edwards speaks of? How do we know it and how is it possible to tell whether the regional glands or peri-rectal tissue are involved or not? We might better remove too much in a very occasional case than too little most of the time.

A second group believes, but does not give us any proof, that the posterior operation gives as good late results and a much lower immediate mortality than the abdomino-perineal operation. But the only statistics of any value are those for the posterior operations of some years ago. When several large groups showed that 16 per cent. lived three years, and that the operability was about 25 per cent., these figures do not compare favorably with an operability of 60 per cent. and 46 per cent. of three-year "cures," even though the mortality is lower. The mortality in the posterior operation as recently given by Lockhart-Mummery was 5 per cent., while Crile reported twenty cases without a death.

A third group, which is most persistent, states that as much intestine can be excised from below as from above. This may be granted, but what is of importance is that it is impossible to remove more than a small part of the peri-rectal fat and mesentery except in a very few favorable cases. It is time that this fallacy should be disposed of for all time. If it is not necessary to remove peri-rectal fat and mesentery, it may be granted that all that it is necessary to remove may be removed posteriorly. It is possible, we believe, to settle all these questions by statistics.

We believe that it is the greatest importance to consider carefully these statistics of Hausmann, which state that in patients dying of carcinoma of the intestines, but 50 per cent. of them show any growth outside of the bowel wall. This means that if we could find some method of removing the growth by a narrow margin without implanting the cells in the surrounding tissue, we would be able to cure permanently 50 per cent. of all cases seen by us; but what are the facts?

Up to 1915 several large groups of cases operated upon by the posterior route showed that probably not over 25 per cent. of the cases seen were

operated upon, and after this careful selection there was a mortality of 16 per cent., and of those surviving the operation, but 16 per cent. lived three years; that is, about 4 per cent. of the patients seen lived for three years, instead of 50 per cent. being permanently cured, as should be if Hausmann's observations are correct.

If we consider the Sir Harrison Cripps' series, which is the best for the posterior route that I know of, we find that 9 per cent. of the total number seen were alive three years later.

If we now consider the most extensive operation the one coming nearest the ideal, that is, the combined abdomino-perineal operation of Miles, in which there is no possibility of implantation of cells directly from the growth, we find that 22.7 per cent. of the total number seen will be alive at the end of three years, and 11.3 per cent. at the end of five years. It will be seen that while this is a great improvement over the posterior operation, this number is far below the 50 per cent. of permanent cures which Hausmann's statistics lead us to believe should be our goal. As it is impossible to implant cells by direct contact with the growth in the one-stage abdomino-perineal operation, we are forced to the conclusion that we scatter cells through the lymphatics, beyond the field of operation in 39 per cent. of the cases operated upon, or Hausmann's observation is not correct. If Hausmann's statement is correct, it is a severe indictment of our present method of operating, and we must begin at once to change our technic in order to make it possible to avoid the dissemination of cancer cells. It is our opinion that Hausmann's statement is not entirely correct, for we believe that cells were already scattered about at the time the autopsies were made, but were not found by him, for in the cases operated upon in which no metastases were found the recurrences are not evident in many cases for one, three, five, or even more years.

If with the most extensive operation we can do we can only have 11.3 per cent. of the patients seen by us walking about the streets at the end of five years, how can we take any interest in remarks such as I have quoted above by Mr. Brown, who has a "considerable portion" of the patients operated upon by him in the last fifteen years, walking about the streets at the present time?

Is it not time that the value of various operations should be determined definitely by figures rather than by the impressions of surgeons, which are admitted by everybody to be particularly fallacious? Because some surgeon decides to do a perineal operation in the great majority of cases, and states that he *thinks* the late results are as good as in the abdomino-perineal operation, it is not necessarily so. If the results are as good, then he must have improved very much upon any posterior operation which had been done previously.

Those surgeons who believe in local excision, those who believe in leaving the sphincter, those who believe in resection by a narrow margin and end-to-end suture, and those who believe in the posterior operation not as occasion-

ally necessary, but as the operation of choice, should give us the proportion of cases operated upon to those seen, and their end results, for they have all been done enough times to give us definite knowledge as to the late results.

We hold no brief for any particular operation, but we do feel that it is the duty of surgeons who are doing this work to look to the end results and not merely to the immediate mortality. What we want is the operation that will give us the largest number of living patients at the end of three or five years out of the total number seen. It seems to us that any operation is of very little value, no matter how low the immediate mortality is, if but 25 per cent. of the cases seen can be operated upon. We should not advise an operation which preserves the sphincter and gives but a year of relief, for it is well known that patients soon accustom themselves to a colostomy, and an extensive operation with a colostomy gives a much longer period of relief.

It makes very little difference what Hausmann says about the localization of the growth in the intestine, nor does it make any difference what Mr. Edwards, Mr. Paul, or Mr. Brown says, the hard fact remains that we are able to operate upon not more than 65 per cent. of the cases seen, and that but 11.3 per cent. of the total number are alive five years later, even with an extensive operation. It is also true, we believe, that not over 2 per cent. of all are alive ten years later. The facts are about the same as Doctor Bloodgood expresses them about carcinoma of the breast: "They are all dead, that is certain, no matter what they died of."

Before we consider any operation, it is well to get all possible facts in regard to the lymphatic drainage of the rectum. Probably the most reliable and comprehensive description of the lymphatics is that of Mr. Ernest Miles, who divides them into three zones. (1) Zone of downward spread; that is, the perineal skin, ischio-rectal fat, and external sphincter. (2) Zone of lateral spread, which includes the levators, retro-rectal lymph-nodes, those in relation to branches of the internal iliacs, prostate, base of bladder, posterior vaginal wall, and base of broad ligaments. (3) Zone of upward spread, that is, the peritoneal floor of the pelvis, pelvic mesocolon, paracolic lymph-nodes, and a group of glands at the bifurcation of the left common iliac artery. These zones were mapped out by Miles from recurrences following four series of cases, the operation in each succeeding series being more extensive than in the preceding. It is the zones of upward and downward extension of Miles which are of the greatest importance in determining the operation to be advised. If we accept Miles' work on the lymphatic involvement in cancer of the rectum, and we believe it is the most convincing work that has been done, there will be very little difficulty in determining the type of operation best suited for the removal of carcinoma of the rectum. This means the removal of the main lymphatic channels, which follow the course of the superior hemorrhoidal and inferior mesenteric arteries, and a complete dissection of the pelvis. This can only be done by an abdominal operation. It also means that the sphincter, ischio-rectal fat, levators, and peri-rectal fat must be removed,

which can be done through a perineal incision. This means a permanent colostomy. The ideal operation, therefore, is a combined abdomino-perineal operation in one stage. While this is the ideal operation we believe that it is impossible to use it in all cases, because of the high mortality in certain groups. We must, therefore, depart from the ideal to whatever extent is necessary to accomplish removal of the growth, and keep out immediate mortality within reasonable limits.

An operation which we consider next in severity to the above operation is the abdomino-perineal operation in two stages. The high mortality in the two-stage abdomino-perineal operation as given in the appended table is largely due to our firm belief, that this operation could be done by sectioning the sigmoid, infolding the distal end and placing it below the peritoneal flaps at the first operation. We found that it made no difference how carefully the distal end was turned in, there was infection about it at the second operation, and in a large proportion of cases the infection caused a fatal peritonitis. After repeated efforts and changes in technic, the operation was given up and the two-stage operation described by one of us in 1915 was again taken up with much lower mortality. The abdominal portion of this operation is carried out exactly as in the one-stage operation, except that the bowel is not sectioned. Instead the upper sigmoid or lower descending colon is brought into the abdominal wound for a lateral colostomy. The arches of the sigmoidal vessels are carefully preserved in order to supply the portion of bowel below the colostomy. The rectum, and greater portion of the sigmoid with its mesentery, are placed in the pelvis and covered with peritoneal flaps. Five days to one week later, the rectum is removed from below, as in the one-stage operation, after the sigmoid is clamped, sectioned and infolded at the peritoneal floor.

This operation is one of great value in cases of partial obstruction in patients over sixty years of age, in the feeble, and in the fat patients, especially men. The objections to it are the discomfort of two operations, and a somewhat prolonged convalescence, but perhaps the most important objection to it is the dissection of the pelvis, freeing up of the growth, and leaving the growth *in situ* for several days. Implantation of cells might be expected to take place, but our statistics seem to show that the duration of life is about as long after the two-stage as after the single-stage operation, as will be shown later.

As many cases are too feeble, too much obstructed, too fat, or too old, to withstand successfully an abdomino-perineal operation of either one or two stages, the operation used by Lockhart-Mummery recently, that is, a colostomy without any dissection above, followed some days or weeks later by amputation of the rectum by the perineal route, has been found of great value. The mortality is low, 5 per cent. in the hands of Mr. Lockhart-Mummery.

A fourth operation which we use only very occasionally is an abdomino-perineal operation in one stage, in which the sphincter is retained and the end of the sigmoid is pulled down through the sphincter muscle after resection



of the growth. We believe that this operation should be chosen only occasionally, for we believe that the percentage of recurrence will be higher, and the chance of failure to obtain a useful sphincter good. We have used the operation but eight times with 50 per cent. of failures.

A fifth operation which we have used very little was reported by the Mayo Clinic. When the patient is not sufficiently strong to withstand an abdomino-perineal operation and the growth is above the peritoneum, the sigmoid and rectum are freed with mesentery and peri-rectal fat, and the bowel sectioned below the growth. The growth and sigmoid are then brought out of the wound for a permanent colostomy, after removal of the growth and a large portion of the sigmoid. The distal end of the rectum is infolded, and the sphincter cut to avoid the collecting of secretions in the rectum.

With these five operations we believe that it is possible to reduce the immediate mortality to a reasonable percentage, 10 per cent., or below, and at the same time give the patient the nearest approach to the ideal, the abdomino-perineal operation of Miles.

It is important, we believe, to be equipped with an operation suitable for any type of case, for removal of the growth should be undertaken whenever there is a reasonable hope of success. While a colostomy alone may give some relief, it is not to be compared to the relief obtained by removal of the growth, and we consider that the patient is repaid if he gets one year of comfort.

No operation with a mortality of 25 per cent., which has been about the average for the abdomino-perineal operation, could be considered for a disease of short duration or one in which the patient is moderately comfortable, but in carcinoma of the rectum we have a disease of long duration, an average duration of eleven months after the patient presents himself and is refused operation, also a most uncomfortable disease during those eleven months. The discomfort is so great that a mortality of 25 per cent. does not appeal to us as unreasonable. That this high mortality is necessary with a proper selection of operations, we do not believe.

Our operative mortality, as shown by the tables below, is 33 per cent. for the abdomino-perineal operation. This mortality we believe to be excessive, because it includes all cases done by us since the earliest operation. It is also excessive because the abdomino-perineal operation was attempted in all cases for a considerable period of time, and because we insisted upon section of the sigmoid and inversion of the distal end for a long period before it was appreciated that it could not be done without.

We believe that our own statistics which include all that we have done in private give a much more accurate estimate of the immediate mortality in the abdomino-perineal operation, that is, 5.3 per cent. for the one-stage operation and 10.6 per cent. for the two-stage operation, or a combined mortality of 8 per cent. Perhaps an idea of what can be done in cancer of the rectum by a judicious choice of operations is shown by the last twenty-four consecutive

# JONES AND MCKITTRICK

cases, without a death. These twenty-four operations include six posterior and eighteen abdomino-perineal operations. It will be seen, therefore, that it is not necessary to give up the abdomino-perineal operation because of the high mortality, but necessary rather to select the proper operation for the patient to be operated upon. That the lower mortality is not due to a more

## TOTAL NUMBER OF CASES 128

*Operability 52½ per cent.*

Operation	Number of cases	Deaths	Mortality Per cent.	No report	Living under 3 years	Living under 5 years	Per cent. 3 year "cures"	Per cent. 5 year "cures"	Duration of life
Adomino-perineal									
One-stage....	31	5	16	2	14	18	46½	18	46 mos.
Two-stage....	68	20	29	5	19	29	36½	13	50½ mos.
Colostomy and perineal .....	23	5	22	5	9	9	11	11	39½ mos.
Harrison-Cripps	4	0	0	0	0	0	0	0	0
Kraske .....	1	0	0	0	0	0	0	0	0
Colostomies ....	62	5	8	20	0	0	0	0	10½ mos.

careful selection of cases is shown by the fact that the low mortality was obtained in the group in which the operability was 60 per cent., while the mortality of 33 per cent. was obtained in a group in which the operability was 52½ per cent.

The end results, as to local recurrence, glandular, visceral, and bone metastasis have been very disappointing because of our inability to get many

## TOTAL NUMBER OF CASES 50

*Operability 60 per cent.*

Operation	Number of cases	Deaths	Mortality Per cent.	No report	Living under 3 years	Living under 5 years	Per cent. 3 year "cures"	Per cent. 5 year "cures"	Duration of life
Abomino-perineal									
One-stage ....	19	1	5.3	0	13	15	60	33	45½ mos.
Two-stage....	19	2	10.6	0	8	11	55	33	49 mos.
Colostomy and perineal .....	12	2	16	2	5	5	0	0	12½ mos.

of our patients to return, because of the fact that many come from a considerable distance. Letters from patients, or the doctors in charge of the cases, are of very little value.

The statement of the pathologist, that 68 per cent. of the cases operated upon show no involvement of peri-rectal tissue or glands, is of interest because it bears out Hausmann's statement that the growth is confined to the bowel in

## CARCINOMA OF THE RECTUM

50 per cent. of the cases. The same answer must be made to the statement of the pathologist as to that of Hausmann, that is, all but 11.3 per cent. or less of the cases seen are dead within five years, whether there are metastases found outside the bowel or not.

Total number of cases .....	116
Pathological report missing .....	6
Number of cases under consideration .....	110
Glands of pelvis involved at operation .....	24
Liver metastases at operation .....	4
Peri-rectal tissue involved .....	16
Prostate involved .....	2
Metastases outside of bowel .....	46
Percentage of cases with metastasis at time of operation .....	42%

Probably the most significant statement is that of the cases operated upon: fifteen died in three years or less, and 92 per cent. of these cases had metastases in the liver, regional glands, or had peri-rectal involvement at the time of operation.

Number of patients who died three years or under .....	15
Liver, mesenteric glands, or peri-rectal tissue involved at time of operation.	92%
Liver .....	2
Mesenteric glands .....	6
Peri-rectal tissue .....	3
No pathological report .....	2
No metastases outside bowel wall .....	2

In contrast to this, there were twenty-two cases living three or more years and in only 23 per cent. were the glands or peri-rectal tissue involved at the time of operation.

Total number living three or more years.....	24
No pathological report.....	2
Number of cases under consideration.....	22
Metastases outside of bowel wall.....	5
Metastases outside of bowel wall.....	23%

There were metastases in the liver in 5 per cent. of the total number of cases seen, that is, 245.

As to the recurrences, very little of value can be determined from our statistics, as we were able to get reports on only twenty-two cases, and we do not feel that they are very accurate.

There were metastases in the liver once, pelvic glands once, inguinal glands from growth above the sphincter twice, abdominal wound once, and perineal wound three times. The pelvis was apparently the seat of recurrence in fourteen cases.

# JONES AND McKITTRICK

## POST-OPERATIVE INVOLVEMENT

Liver.....	1
Glands in abdomen.....	1
Glands in groin.....	2
Abdominal wound.....	1
Perineal wound.....	3
Pelvis.....	14

22

While it is evident from these statistics that 92 per cent. of the cases dying within three years had involvement of the liver, regional glands, or peri-rectal tissue, at the time of operation, it would not be wise to give up operating upon these cases for twenty-three per cent. of those having metastases in the regional glands or peri-rectal tissue, live three or more years, and we believe very firmly that a patient is well repaid for the discomforts of the operation if he gets a year of comfort.

## MASSACHUSETTS GENERAL HOSPITAL SCHEME FOR REPORTING END RESULTS

A. Total Entries .....	284	
B. Re-entries .....	0	
C. Recurrences from Previous Operations.....	2	
C. Refused Operation.....	38	
D. Cases available for Study.....	244	
E. Radical Operations.....	128	
F. Palliative.....	60	
G. Exploratory and No Operation .....	56	
H. Operative Deaths.....	36	
I. Operative Mortality		
(a) Radical Operation .....	31 .....	24%
(b) Palliative Operation .....	5 .....	8%
(c) Exploratory Operation .....	0 .....	0%
J. Operability. Radical.....		52½%
K. Operability. All Operations .....		82½%
L. Inclusive. Lack Pathological Report. ....		0
M. Inclusive. Untraced. ....		12
N. Useless for this Series		
(a) Exploratory or No Operation.....		56
(b) Colostomies.....		60
		<hr/> 128
O. Cases available for End Results.....		116
P. Abdomino-Perineal Operations .....		92
Q. Perineal Operations.....		23
R. Number of Cases Living Three Years .....		25
S. Number of Cases Died without Recurrence .....		0
T. Number of Three Year "Cures" Abdomino-Perineal .....		23
U. Number of Three Year "Cures" Radical Operation .....		2
V. Percentage of Three Year "Cures" Radical Operation.....		40%
W. Percentage of Three Year "Cures" Perineal Operation.....		15%

## END RESULTS OF THE SURGICAL TREATMENT OF CARCINOMA OF THE CERVIX UTERI\*

BY LINCOLN DAVIS, M.D.

OF BOSTON, MASS.

THE enthusiastic acclaim which has greeted the use of radium in the treatment of cancer of the cervix has well nigh put a stop to the operative treatment of this disease, in many of the large clinics of this country. So far has the pendulum swung, that one now hears the radical operation called some very hard names by those who formerly were its ardent supporters. While well aware of the remarkable effects of radium upon certain types of cancer, and willing to grant that as a palliative measure in cancer of the cervix it has no equal, I must confess to an unwillingness as yet to abandon the operative treatment of this disease in appropriate cases, until more evidence of lasting cures by radium is at hand. Radium by its encouraging results in advanced cases has doubtless earned for itself the right to a fair trial alongside of surgery in the more favorable cases. It is obviously unfair to refer for treatment by radium only hopelessly advanced cases while retaining all early cases for surgical treatment. The employment of radium, however, in locally favorable cases in which there are contra-indications to surgical operation on the part of the general system, should provide in due time ample means for a fair comparison of results obtained by both procedures.

This small series of cases is presented as a feeble, perhaps, but nevertheless sincere, protest against the premature abandonment of a procedure which has proved itself of real curative value in the past, and is I believe capable of a still better record in the future, until the superiority of radium to surgery has been definitely established.

Dr. Farrar Cobb † reported in 1920 a series of thirty-five cases of radical abdominal hysterectomy for cancer of the cervix with an operative mortality of 11.6 per cent. and 57 per cent. of five-year "cures." Twenty-six of his cases were from the records of the Massachusetts General Hospital in the period from 1901-1915, with eleven five-year "cures," or 42 per cent.

Since September, 1915, I have had the opportunity of taking up the assignment of the operative treatment of cancer of the cervix at the Massachusetts General Hospital, and have continued it since, with an interruption of a little over two years, occasioned by the war. The number of cases subjected to radical operation has been small, but the results, although not quite equalling those of my predecessor, have been sufficiently encouraging to warrant, I believe, a continuance of the procedure in appropriate cases for the present.

*Operation.*—Total abdominal hysterectomy, including a liberal cuff of

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\* Read before the American Surgical Association, May 1, 1922.

† Journal A. M. A., January 3, 1920, vol. lxxiv pp. 14-17.

vaginal wall, and wide removal of parametrial tissue, is the operation of choice. This operation has been done in thirty-one cases. Systematic dissection of the pelvic lymph-nodes has not been attempted. Ligation of the internal iliac arteries has not proved in my hands to be of material advantage, and has been given up since the early cases. In cases presenting a bulky cauliflower outgrowth from the cervix, filling the vault of the vagina, preliminary curettage and cauterization, followed ten days later by radical hysterectomy, has been done. Otherwise the operation is done in a single stage without cauterization or curettage of the growth.

Simple curettage and cauterization, or cauterization combined with ligation of internal iliac and ovarian vessels, has been done in a number of cases in earlier years as a palliative measure, but lately has been entirely abandoned in favor of radium in those cases in which radical operation is contra-indicated.

Vaginal hysterectomy has been done in a single case in which the disease was discovered at an early stage and seemed to be entirely confined to the cervix. This procedure is not advocated except under unusual circumstances.

*Operative Mortality.*—In the total of thirty-two cases of hysterectomy for cancer of the cervix, thirty-one radical abdominal operations and one vaginal hysterectomy, there have been three operative deaths, an operative mortality of 9.3 per cent. There has been no mortality in the twelve cases operated on since 1917.

*Operability.*—In estimating the final value of any operative procedure for the cure of cancer, the operability rate is the crux of the situation. Statistics are notoriously plastic, and in no respect are they more so than in regard to operability. The figures in this series of cases are compiled solely from personal cases examined at the Massachusetts General Hospital, in the period from 1910–1922, and do not include a considerable number of cases which entered the services of other surgeons on the staff during this time. From September, 1915, to May, 1917, and from July, 1919, to date, during which periods I have held the special assignment of these cases, practically all such entries have been referred to my service. On the whole the cases seen represent a fair cross-section of the material which enters this hospital, no selection of cases being possible. Excluding re-entries there have been eighty-five cases of unquestionable carcinoma of the cervix examined by me, of these thirty-two have been subjected to an operative attempt at cure by hysterectomy. The operability rate for the entire period is 37.6 per cent.

Since July, 1919, the radical operability rate has fallen still further to 33 per cent. of the thirty-six cases seen, in spite of an active publicity campaign carried on in the community with the object of securing early recognition of the disease.

*Standard of Operability.*—This is difficult to express in words. Hysterectomy has been undertaken in all cases in which the disease was apparently confined to the cervix, or had invaded the vaginal walls to a limited extent. Mere bulk of the cervical outgrowth into the vagina, has not been considered

a contra-indication, nor has limited parametrial invasion. Actual involvement of the rectal or vesical walls is now considered a contra-indication, also massive infiltration of the broad ligaments, as determined by rectal palpation. Mere fixation of the growth in the pelvis has not been found to be a contra-indication, as in several cases this has been proved by laparotomy to be due to inflammatory exudate and adhesions.

In the early cases, unwise attempts were made at radical removal when the growth was very extensive, necessitating resection of portions of the bladder and rectum; such radical procedures led to distressing complications and sequelæ in the nature of fistulæ, and in no case resulted in cure, and are not now undertaken. Cases operable as far as the local disease is concerned, but which presented contra-indications elsewhere in the body, as, for instance, by reason of obesity, diabetes, cardiac or pulmonary disease, have been referred for radium treatment, and offer a fair measure of comparison of results which will guide our future policy in handling this disease.

Every case without exception in which the radical operation has been done presented unmistakable clinical evidence of the disease in the cervix. There was not a single case of precancerous type, or of unsuspected microscopic diagnosis.

*Complications.*—It cannot be denied that there have been distressing complications, following the radical operation, in those patients who have survived. Of the seventeen survivors of the radical operation performed more than five years ago, there were four afflicted with urinary fistulæ. In one of these cases the fistula fortunately closed spontaneously during convalescence. In another case a vesico-vaginal fistula was successfully repaired at a later operation. In one case in which a portion of the rectum was deliberately resected on account of infiltration of its wall by malignant disease, there was a recto-vaginal as well as a vesico-vaginal fistula. As signs of recurrence rapidly ensued in this case, attempts at repair were not persisted in. In the fourth case, a ureteral fistula, there was also rapid recurrence, so that operative repair was not attempted. Post-operative shock was noted in three cases. Pyelitis, phlebitis, cystitis, and wound sepsis were recorded once each as complications occurring during the course of convalescence.

The prevalence of urinary fistulæ in these cases can be ascribed largely to errors of technic and judgment. The operator was acquiring his early experience. A more conservative selection of cases, with substitution of rubber or rubber tissue for gauze drainage, avoidance of stripping bare the ureter for considerable distances, and gentleness in its handling, have reduced the incidence of this most distressing sequela in later cases, and yet with all care, ureteral fistula the result of necrosis remains the great bugbear of the operation, an inherent risk of thorough removal of parametrium.

*End Results.*—Only cases operated on prior to May, 1917, are available for the study of end results. There have been twenty cases of attempted operative cure during this period, nineteen radical abdominal hysterectomies

# LINCOLN DAVIS

TABLE I  
End Results: Carcinoma Cervix Uteri  
(Greenough Formula).

A. Total of personal cases (1910-1922).....	91
B. Re-entries.....	0
C. Recurrence from previous operation } .....	6
D. Cases available for study of operability, mortality, etc.....	85
E. Radical operation.....	32
F. Palliative operation.....	35
G. No operation.....	18
H. Operative deaths.....	4
Radical operation.....	3
Palliative operation.....	1
I. Operative mortality .....	6%
Radical operation.....	9.3%
Palliative operation.....	2.8%
J. Operability: Radical.....	37.6%
K. Operability: All operations.....	78.7%
L. Inconclusive cases: Lack pathological examination. Pathological examination in all operated cases)	
M. Inconclusive cases: Untraced. (All operated cases traced)	
N. Inconclusive cases: Died within time limit without recurrence..	0
O. Cases available for end-result data, <i>i.e.</i> , cases operated upon previous to May, 1917.....	46
P. Radical operations.....	20
Q. Palliative operations.....	26
R. No operations.....	0
S. Number of cases alive and well (5 years).....	7
T. Number of cases died without recurrence .....	1
U. Number of 5-year "cures" (all operations).....	8
V. Number of 5-year "cures" (radical operation).....	8
W. Percentage of "cures" (all operations) .....	17.4%
X. Percentage of "cures" (radical operation).....	40%

TABLE II  
*Results of Hysterectomy*

Radical abdominal hysterectomies.....	31
Vaginal hysterectomy.....	1
Total.....	32
Operative deaths.....	3
Mortality.....	9.3%
Cases operated on previous to May, 1917.....	20
Number of cases traced.....	20
Alive and well over 10 years.....	1
Died of cerebral hemorrhage, without signs of recurrence 7 years after operation.....	1
Alive and well over 5 years.....	6
(One case reported well by letter, 4 years and 4 months after operation showed beginning local recurrence at end of 5th year. Died 5 years and 10 months after operation.).....	1
Recurrence in 2¾ years.....	1
Recurrence within 1 year.....	7
Operative deaths.....	3 15%
5-year "cures".....	8 40%



## CARCINOMA OF THE CERVIX UTERI

and one vaginal hysterectomy. All cases have been proved to be cancer of the cervix by microscopic examination of the tissue removed. All twenty cases have been traced.

In three cases death occurred as an immediate result of the operation, giving an operative mortality of 15 per cent. This percentage has been reduced by subsequent cases to less than 10 per cent.

In seven cases the patients are now living and well, more than five years after operation.

In one of these cases, more than ten years has elapsed since the operation.

In one case the patient died of cerebral hemorrhage without sign of recurrence, seven years after operation.

This gives a total of eight five-year "cures," or 40 per cent.

*Recurrence.*—Recurrence of disease has been noted in a total of nine cases; it took place within one year of operation in seven cases.

In one case recurrence was first noted two years and nine months after operation.

In one case, reported well by letter four years and four months after operation, local recurrence was noted at the end of the fifth year. The patient died five years and ten months after operation.

All recurrences in these cases were local in the pelvis, except in one where the stomach and liver were stated by the attending physician to be the site of recurrence.

One case classed as a "cure" in which death from cerebral hemorrhage occurred seven years after operation, might be objected to on the ground that the cerebral condition was in the nature of a recurrence. The fact that the patient had been repeatedly examined during the first five years and found free from recurrence, and that her cerebral attack occurred very suddenly during apparent good health, and finally that there had been a previous hemiplegia prior to operation, amply justifies, I think, the exclusion of recurrence as a factor in this case.

If the three-year period of freedom from recurrence is taken as a standard of "cure" the percentage would be raised only five points to 45 per cent.

The most gratifying evidence of the efficacy of the radical abdominal operation is furnished by two cases, hospital numbers 209616 and 212108, in which microscopic examination of the specimens removed showed definite infiltration of epidermoid cancer into the tissues of the parametrium, yet the patients remain well more than five years after operation.

### ABSTRACTS OF CASES OF HYSTERECTOMY FOR CANCER OF CERVIX PREVIOUS TO MAY, 1917, MASSACHUSETTS GENERAL HOSPITAL

CASE I.—F. M. T. Hospital No 170,569 E. S. July 1 1920. Age thirty-five. Married, no children, two miscarriages. Referred from Free Hospital for Women, Brookline. Shock five years ago with hæmiplegia which has partially cleared up.

*Symptoms.*—Constant flowing for three months.

## LINCOLN DAVIS

*Examination.*—Very obese anæmic woman. Vault of vagina occupied by friable bleeding growth. Some thickening in region of both broad ligaments.

*Operation.*—Preliminary curettage and cauterization. Ten days later radical abdominal hysterectomy.

*Complications.*—Vesico-vaginal fistula successfully repaired at second attempt in December, 1910.

*Pathological Report.*—Carcinoma of cervix. F. C. Kidner.

*Result.*—September 12, 1916, personal examination: No recurrence. General health excellent. March 3, 1920, letter from a friend, states that patient died suddenly of cerebral hemorrhage, July 29, 1917. Her health had been excellent up to this time.

CASE II.—C. M. D. Hospital No. 177308 E. S. July 21, 1911. Age forty-two. Married.

*Symptoms.*—Excessive flowing for several years. Pain in lower abdomen and back for four months. Two months ago had some operation on womb at another hospital.

*Examination.*—Cervix lacerated and nodular; small cauliflower outgrowth from cervix; uterus movable.

*Operations.*—Preliminary curettage; radical abdominal hysterectomy, ten days later.

*Complications.*—None.

*Pathological Report.*—Carcinoma of cervix. H. F. Hartwell.

*Result.*—August 14, 1913, patient writes "feel grand, gained 40 pounds. January 25, 1915, personal examination, condition excellent; no recurrence. October 25, 1921, patient reports by letter, that she is in perfect health. Has led an active out-of-door life in the mountains of Colorado during past summer.

CASE III.—J. B. F. Hospital No. 183959 E. S. July 24, 1912. Age seventy-three, widow, menopause twenty years ago. Seven children.

*Symptoms.*—For six months pain and soreness in lower abdomen and frequency of micturition. Bloody discharge, for six weeks. Has lost 20 pounds in six months.

*Examination.*—Cervix lacerated; bleeds on touch; uterus enlarged and movable.

*Operation.*—Radical abdominal hysterectomy, both broad ligaments markedly infiltrated by disease.

*Complications.*—Urteral fistula.

*Pathological Report.*—Epidermoid cancer of cervix. H. F. Hartwell.

*Result.*—Rapid recurrence in pelvis with hydronephrosis. Died, February 22, 1913.

CASE IV.—A. V. D. Hospital No. 188637 E. S. April 17, 1913. Age fifty-eight. Widow. Menopause five years ago. One child, one miscarriage.

*Symptoms.*—Two months ago noticed bloody discharge. No pain. Easily fatigued.

*Examination.*—Small frail woman. Soft friable bleeding mass protrudes from cervix. Uterus somewhat fixed. Vaginal wall involved.

*Operation.*—Preliminary curettage and cauterization followed in 11 days by radical abdominal hysterectomy. Resection of portion of bladder and rectum on account of invasion by growth, with suture.

*Complications.*—Rectal and vesical fistulæ. May 27, 1913, unsuccessful attempt made to repair fistulæ.

*Pathological Report.*—Cancer of cervix. Infiltration of outer wall of intestine. W. F. Whitney.

*Result.*—Rapid local recurrence. Died of the disease, March 13, 1914.

## CARCINOMA OF THE CERVIX UTERI

CASE V.—L. F. Hospital No. 201203 E. S. April 9, 1915. Age forty-three, married. Seven children, one miscarriage.

*Symptoms.*—Two months ago bleeding after coitus. For the last month flowing has been constant. No pain.

*Examination.*—Short obese woman with protuberant abdomen. Hard irregular nodular cervix with induration in left broad ligament.

*Operation.*—Radical abdominal hysterectomy.

*Pathological Report.*—Carcinoma of the cervix. W. F. Whitney.

*Result.*—Death from shock in a few hours.

CASE VI.—S. I. Hospital No. 202459 E. S. June 21, 1915. Age forty, married. Five children, three miscarriages.

*Symptoms.*—Constant flowing for six months, indefinite pelvic pain.

*Examination.*—Cervix hard and nodular, somewhat fixed.

*Operation.*—Radical abdominal hysterectomy.

*Complication.*—Bladder wall lacerated-sutured.

*Pathological Report.*—Squamous-cell carcinoma. J. H. Wright.

*Result.*—Death from shock in six hours.

CASE VII.—M. F. W. Hospital No. 204342 E. S. September 23, 1915. Age fifty-six, widow, one child. Menopause 10 years ago.

*Symptoms.*—Slight show of blood five years ago. Repeated hemorrhages during last year. No pain.

*Examination.*—Small cauliflower growth of cervix with ulceration and sloughing. Uterus freely movable.

*Operation.*—Radical abdominal hysterectomy.

*Complication.*—Phlebitis of left leg.

*Pathological Report.*—Carcinoma of cervix. W. F. Whitney.

*Result.*—January 19, 1920, patient reports by letter that she is well and working every day. September 24, 1920, slight recurrence detected in the vault of vagina, R Radium. Death in July, 1921, "cancer of bladder."

CASE VIII.—A. M. Hospital No. 205520 E. S. December 3, 1915. Age fifty-four, married. Menopause eight months ago. Two children, two miscarriages.

*Symptoms.*—"Ulcerated womb" for over twenty years. For six months blood tinged, offensive discharge, with pelvic pain.

*Examination.*—Cervix hard and nodular. Palpation caused profuse bleeding, requiring packing.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—None.

*Pathological Report.*—Carcinoma of cervix. W. F. Whitney.

*Result.*—January 4, 1917, granulating surface in vault of vagina, bleeds on touch. R Radium. November 18, 1918, definite recurrence in right side of pelvis.

CASE IX.—A. W. Hospital No. 208443 E. S. May 24, 1916. Age thirty-eight, married, eight children.

*Symptoms.*—Severe pain in lower abdomen for three months. Bleeding on coitus. Laparotomy at another hospital three months ago. Blood-vessels tied, nothing removed. Cervix cauterized.

*Examination.*—Friable, bleeding mass in vault of vagina, resistance in both lateral cul-de-sacs. Fundus retroverted.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—Some post-operative shock.

*Pathological Report.*—Carcinoma of cervix. W. F. Whitney.

*Result.*—February 12, 1920, feels perfectly well. Personal examination shows no sign of recurrence. November 3, 1921, patient writes that her condition is excellent.

CASE X.—M. C. S. Hospital No. 208619 E. S. May 31, 1916. Age fifty-two, married, eight children.

*Symptoms.*—Persistent flowing for eight months. Heavy bearing-down pain in pelvis.

*Examination.*—Poorly nourished woman. Uterus movable, prolapsed, with a crater at cervix.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—None.

*Pathological Report.*—Carcinoma of cervix. H. F. Hartwell.

*Result.*—December 2, 1921, excellent health. Examination shows no sign of recurrence. Patient shown at meeting of Clinical Surgical Society in Boston.

CASE XI.—A. B. Hospital No. 208709 E. S. June 5, 1916. Age sixty-two, married. Menopause, sixteen years ago. One child.

*Symptoms.*—Flowing began two months ago, and has continued since. Pelvic pain for last few days.

*Examination.*—Cervix replaced by a hard mass with a crater in centre, marked infiltration in post cul-de-sac.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—Pyelitis.

*Pathological Report.*—Carcinoma of cervix. H. F. Hartwell.

*Result.*—Patient died of the disease in 1917.

CASE XII.—C. B. Hospital No. 209134 E. S. June 30, 1916. Age forty-four, married, one child, one miscarriage.

*Symptoms.*—Nine months ago noticed bloody discharge from vagina after a douche. For the last four months has had a persistent profuse watery discharge. No pain.

*Examination.*—Friable nodular mass projecting from both lips of cervix. No induration in broad ligaments.

*Operation.*—Preliminary curettage and cauterization. Ten days later, radical abdominal hysterectomy.

*Complication.*—Some post-operative shock.

*Pathological Report.*—Carcinoma of cervix. H. F. Hartwell.

*Result.*—Patient died of the disease in 1917.

CASE XIII.—P. P. Hospital No. 209616 E. S. July 24, 1916. Age forty-seven, widow; eleven children.

*Symptoms.*—Pain in lower abdomen. No note as to bleeding.

*Examination.*—Cervix replaced by hard ulcerated bleeding mass fixed in the right vault.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—Temporary leakage of urine, which ceased spontaneously in a few days.

*Pathological Report.*—Carcinoma of cervix, with invasion of right parametrium. H. F. Hartwell.

*Result.*—November 4, 1921, patient has every appearance of perfect health. No symptoms. No evidence of recurrence on examination.

CASE XIV.—K. P. Hospital No. 211552 E. S. November 10, 1916. Age forty-nine, widow, one child.

*Symptoms.*—Irregular flowing for eight years. No pain, has lost fifty pounds in one year.

*Examination.*—Cervix replaced by a fungating, ulcerating growth.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—None.

*Pathological Report.*—Epidermoid carcinoma of cervix. H. F. Hartwell.

## CARCINOMA OF THE CERVIX UTERI

*Result.*—Letter from local physician states patient was well and working when last seen in summer of 1921.

CASE XV.—A. L. B. Hospital No. 212108 E. S. December 11, 1916. Age fifty-three, married; three children. Menopause five years ago.

*Symptoms.*—Heavy feeling in pelvis and backache for four years. Two months ago first noticed brown watery discharge.

*Examination.*—Nodular growth involving cervix, with infiltration of vaginal wall. Left broad ligament infiltrated. Uterus somewhat movable.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—Post-operative shock.

*Pathological Report.*—Epidermoid carcinoma of cervix, with infiltration into left parametrium. H. F. Hartwell.

*Result.*—May 29, 1920, feels well. Personal examination showed no evidence of recurrence. Letter of October, 1921, states that her health continues excellent.

CASE XVI.—T. B. Hospital No. 213354 E. S. February 16, 1917. Age forty-seven, married, two children.

*Symptoms.*—For ten months irregular flowing. No pain.

*Examination.*—Well-developed stout woman. Cervix replaced by a crater with indurated edges. No evidence of involvement of broad ligaments.

*Operation.*—Radical abdominal hysterectomy.

*Complications.*—Clamps left on vessels of pelvic wall for three days.

*Pathological Report.*—Carcinoma of cervix. H. F. Hartwell.

*Result.*—Death from peritonitis on the fourth day after operation.

CASE XVII.—J. A. R. Hospital No. 213387 E. S. February 21, 1917. Age fifty-three, widow, one child, one miscarriage.

*Symptoms.*—One year ago first noticed a pinkish-white irritating discharge from vagina. Two months ago hemorrhage from vagina. Curetting by local M.D., three weeks ago. Report cancer.

*Examination.*—Cervix not remarkable, uterus movable, slightly enlarged. Broad ligaments free.

*Operation.*—Vaginal hysterectomy.

*Pathological Report.*—Epidermoid carcinoma of cervix. H. F. Hartwell.

*Result.*—March 25, 1922, letter from local physician states that patient looks and feels well, and is working regularly as cook.

CASE XVIII.—L. G. H. Hospital No. 213721 E. S. March 12, 1917. Age twenty-nine, married, two children, one miscarriage.

*Symptoms.*—For two months persistent brown watery discharge. Twinges of pain in pelvis for two months.

*Examination.*—Well-nourished young woman. Large cauliflower mass occupies vault of vagina with induration in post cul-de-sac.

*Operation.*—Preliminary curettage and cauterization; ten days later radical abdominal hysterectomy.

*Complications.*—Wound sepsis in abdominal wall.

*Pathological Report.*—Carcinoma of cervix with metastasis in parametrial lymph-node.

*Result.*—Death from recurrence of disease in autumn of 1917.

CASE XIX.—F. W. Hospital No. 214116 E. S. April 10, 1917. Age fifty-six, married. Menopause six years ago.

*Symptoms.*—Three months ago first noticed cramp-like pains in lower abdomen. For one year had had watery discharge and occasional bleeding. For last three weeks bleeding has been profuse.

*Examination.*—Obese woman. Collar of indurated tissue surrounds cervix and extends into broad ligaments.

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*Operation.*—Radical abdominal hysterectomy.

*Complications.*—Cystitis.

*Pathological Report.*—Carcinoma of cervix. H. F. Hartwell.

*Result.*—Patient's physician states that death occurred in December, 1918, with recurrence in stomach and liver.

CASE XX.—S. A. L. Hospital No. 214350 E. S. April 17, 1917. Age thirty-nine, married, six children.

*Symptoms.*—Brownish offensive vaginal discharge for three months. No pain.

*Examination.*—Fungating, bleeding growth size of small apple, replaces cervix, vaginal walls not involved. Fundus of uterus freely movable.

*Operation.*—Preliminary curettage and cauterization, fifteen days later radical abdominal hysterectomy.

*Complications.*—Bladder opened and sutured.

*Pathological Report.*—Carcinoma of cervix. H. F. Hartwell.

*Result.*—Death from recurrence March 5, 1918.

## FACTORS INFLUENCING THE LIFE EXPECTANCY OF PATIENTS OPERATED ON FOR GASTRIC ULCER\*

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THREE years ago I presented before this Association a paper in which it was shown that the subsequent death † rate in patients operated on for duodenal ulcer was not greater than that of the general population of similar age and sex, but that it was three times as great in patients operated on for gastric ulcer. It is well known that gastric ulcer is a more serious disease in every respect than duodenal ulcer: because of the disability from the symptoms it produces, the danger from these symptoms, the less response to medical régime, and the greater risk and the less satisfactory results of surgical treatment. The fact that the subsequent death rate in patients successfully operated on for gastric ulcer proved to be three times the death rate of a similar group of the general population, prompted me to make further investigation, the results of which I desire to place before the Association.

During a period of fifteen years, prior to January, 1921, 1280 patients with gastric ulcer were operated on in the Mayo Clinic. In this series, 195 deaths occurred following satisfactory recovery from the operation. I have endeavored by every possible means to ascertain the causes of these deaths. The information obtained by a review of case histories, by correspondence, by reëxamination, or by further operation shows very clearly that the most important single factor influencing the life expectancy of patients operated on for gastric ulcer is gastric cancer. The exact number of deaths due to gastric cancer cannot be ascertained, but it easily constitutes the most common cause of death. There is, moreover, little doubt that many of the deaths for which no cause was given were due to cancer. Exclusive of these, there were seventy-five deaths from gastric cancer, which comprise about 40 per cent. of the total number of deaths, and the remainder in which the cause is known are, with few exceptions, due to causes independent of the stomach. Gastric cancer, then, may well be regarded as the factor most worthy of consideration, necessitating a review of the pre-operative history of the patient, the character of the gross lesion found at operation, the microscopic picture of the lesion, and the operative method used in dealing with the lesion.

Patients who subsequently died of gastric cancer may be divided into two groups, those in whom the lesion was not removed, and those in whom the lesion was removed. In the first group there is a striking similarity in the description of the lesions found at operation, all conform more or less to the following operative record: "Large ulcer of posterior wall, adherent to

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† Subsequent death in this paper refers to the deaths occurring after the dismissal of the patient from the hospital.

pancreas, involving too much of the stomach and too firmly adherent to warrant the risk of removal. Ulcer may be malignant but unable to get specimen for examination. Glands inflammatory. Posterior gastro-enterostomy." Such cases have been classified in the Clinic as ulcer, but the fact that forty patients succumbed to gastric cancer within two years of operation shows with little doubt that the condition was cancer at the time of operation and should have been classified as gastric cancer or cancer on ulcer, depending on the duration and character of the symptoms previous to operation. As a contribution to the ever-interesting subject of the liability of ulcer to cancer degeneration, I would point out that the patients who died of cancer following gastro-enterostomy or other indirect operations for supposed ulcer presented a history of gastric ulcer for an average of five and eight-tenths years before operation. These cases, at least, should be removed from the benign gastric ulcer group, and this deduction alone makes a very material difference in the life expectancy statistics which have been reported.

A few cases suggest, because of the long time between operation and death from cancer, that malignancy may have developed in the ulcer after the gastro-enterostomy. The rate of growth of gastric cancer is so variable, however, that it would be unwise to hold a positive opinion concerning such cases. There are, however, two clear indications for dealing radically with these large ulcers; namely, the ulcer may be already malignant, or it may take on malignant changes if it is not removed.

Since it is often impossible to determine from the history or any pre-operative tests, or even from operation whether these large ulcers are malignant, and since it is only in the subsequent course of these cases that the real character of an unremoved lesion becomes apparent, radical removal is essential. Radical removal of these large ulcers means, however, a considerably increased operative risk but such treatment would be justified because the subsequent death rate following gastro-enterostomy alone in such cases is at least 25 per cent. Inasmuch as the ulcers are often too large for the safe operation of local excision and gastro-enterostomy, partial gastrectomy must be employed in order to deal adequately with the lesion. When the ulcers are near the pyloric end of the stomach, pylorectomy may be performed restoring gastro-intestinal continuity by Billroth No. 2 or by Polya's method, depending on the ease of approximation of the jejunum and the stomach. Unfortunately, the desirable practice of widely resecting large ulcers cannot be applied in all cases, because of their fixation, size, and situation, or the condition of the patient. Patients in whom the lesion is irremovable and in whom time only will reveal the nature of the lesion, should be placed in a deferred classification.

Summing up the management in this group of large ulcers it may be said that, while gastro-enterostomy alone gives fairly good results for the ulcer which has not undergone malignant change, the impossibility of determining



the question of malignant invasion at the operating table makes wide excision of such ulcers of first importance.

In the group of cases in which the ulcer was removed, there were 130 partial gastrectomies with four (3 per cent.) subsequent deaths from cancer, 296 cautery excisions and gastro-enterostomies with ten (3.3 per cent.) subsequent deaths from cancer, 172 knife excisions and gastro-enterostomies with eleven (6 per cent.) subsequent deaths from cancer and fifty-six sleeve resections with no subsequent deaths from cancer. The low mortality rate from partial gastrectomy is marred by the fact that the subsequent death rate from all causes following this operation is 18 per cent., as compared with 7.5 per cent. for knife or cautery excision with gastro-enterostomy, and 5.12 per cent. for segmental resection.

Broders has kindly examined the available specimens from patients who subsequently died from cancer which were classified as ulcer by the pathologist at the time of operation. He finds, after studying a large number of areas from each specimen, that there is evidence of malignant change in about 50 per cent. This not only illustrates the difficulty of detecting early invasion of an ulcer by cancer, but emphasizes again the necessity of most painstaking search of every gastric ulcer for evidences of cancer degeneration. The difficulties of explaining these deaths from cancer are made greater by the fact that we do not know the incidence of cancer in the stomach from which a benign ulcer has been removed.

The lesson to be learned from the group of cases in which the lesion was small enough to be subjected to excision by knife or cautery and followed by gastro-enterostomy is not clear. Since the death rate from cancer is 3 per cent. after cautery excision, 3.3 per cent. after partial gastrectomy, 6 per cent. after knife excision, and 0 per cent. after sleeve resection, the evidence certainly is in favor of the last operation. In the Mayo Clinic, however, the segmental resections have usually been made in cases in which ulcers are favorably situated and have more or less hourglass contraction, so that the applicability of the operation is limited and the results, therefore, good. Local excision followed by gastro-enterostomy for all other small ulcers seems now to be well established. With regard to the method of excision, the cautery has many advantages and I would like to direct attention to the method of employing the cautery which Sistrunk has introduced in the Clinic. Instead of burning out the ulcer, as I originally suggested, he excises the entire ulcer with the cautery knife; this secures the ulcer for microscopic examination, and the heat may be effectively employed in thoroughly searing the edges of the incision. Although the risk accompanying this method may be slightly greater than in the usual procedure, I believe it is the best technic to use when the ulcer area can be satisfactorily mobilized.

Gastric cancer, then, is the chief factor to be reckoned with in estimating the life expectancy of patients operated on for gastric ulcer. The evidence, however, indicates that in almost all of these deaths from cancer the lesion

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had already undergone malignant changes at the time of operation. For this reason sixty cases should be omitted from this series in reckoning the life expectancy of patients operated on for benign gastric ulcer. On this basis, their life expectancy is considerably better than hitherto reported and the subsequent death rate, instead of being three times the death rate of the general population of similar age and sex, is less than twice the rate.

OPERATIONS FOR GASTRIC ULCER

	Cases.	Subsequent deaths
Partial gastrectomy.....	130	4 ( 3 per cent.)
Cautery excision and gastro-enterostomy.....	296	10 (3.3 per cent.)
Knife excision and gastro-enterostomy.....	172	11 ( 6 per cent.)
Sleeve resection.....	56	

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# RESECTION OF THE BODY OF THE STOMACH FOR ULCER\*

REPORT OF A SERIES OF CASES WITH END RESULTS

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THE impossibility of distinguishing between benign ulcer and carcinoma of the stomach without microscopic examination makes some form of removal of the ulcer necessary. If the ulcer is large or is high on the body of the stomach, if there are multiple ulcers, or if there is hour-glass constriction, resection in continuity is often the most simple operative procedure. This operation, also called transverse, sleeve, or middle gastric resection, is particularly adapted to ulcer with hour-glass deformity, as it removes the lesion and, at the same time, relieves the obstruction. While it results in the removal of more of the wall of the stomach than by simple excision, less is usually removed than by other forms of resection.

Attention has been called to the fact that a stomach in which sleeve resection has been performed will empty better than one in which a V-shaped excision has been made; this has been borne out by experimental results. The reason for this was a matter of conjecture for a long time. Alvarez, in 1919, explained it as follows: The contraction wave starts at the cardia and passes along both curvatures to the pylorus; in order that the stomach may empty completely, the waves of the two curvatures must reach the pylorus at the same time. Sometimes the arrival of one wave at the pylorus seems to block the advance of the wave on the other curvature, therefore, if part of one curvature is removed without removing the corresponding part of the opposite curvature, the wave of one side will reach the pylorus before that of the other and, thus, poor emptying will result. Alvarez, therefore, recommended the removal of a sleeve which is longer on the greater curvature than on the lesser.

The portion of the stomach removed is often the part richest in acid-secreting glands, namely the prepyloric, and theoretically this removal should result in lowering the acidity. Five of our patients had test meals before and after operation. The average time elapsing between the resection and the test made after operation was twenty-one months. The average readings before operation were: total acidity fifty-three, free hydrochloric acid forty-three. The average readings after operation were: total acidity thirty-nine, free hydrochloric acid twenty-nine, an average reduction of fourteen in total acid-

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\* Read before the American Surgical Association, May 2, 1922.

ity and fourteen in free hydrochloric acid. This is a very small series and a positive conclusion should not be drawn from it. De Quervain, and Faulhaber and Redwitz reported a decrease in acidity following sleeve resection. Other factors besides the removal of the acid-secreting mucous membrane may be concerned in lowering the acidity, for the acidity is always reduced after the excision of a duodenal ulcer, which does not disturb the gastric mucous membrane.

Various surgeons have advocated sleeve resection; others have condemned it, and while fairly large series of such operations have been reported from



FIG. 1.—(Case 94543). Stomach before sleeve resection, showing the niche of a gastric ulcer on the posterior wall with a wavy contraction of the greater curvature.

Germany, the procedure has never been popular. First, it is considered more difficult technically than simple excision, but we are inclined to believe that it may often be performed with less difficulty than a V-shaped excision and gastro-enterostomy. Other objections have been made, namely, that the short lesser curvature is still further shortened, that it is necessary to make the resection too close to the ulcer on the lesser

curvature, and that too much of the normal wall of the stomach is sacrificed. The chief adverse criticism is that hour-glass constriction often follows.

Payr, in 1910, recommended sleeve resection in ulcers of the body of the stomach. Riedel recommended it in ulcers of the pars media, and in 1912 reported the condition of eighteen patients who had been operated on from three to eleven years previously. Four were completely cured, and fourteen were perfectly well with the exception that they were unable to eat certain heavy foods. Von Eiselsberg, in 1914, said that it is the operation of choice if the ulcer is situated at a distance from the pylorus or has involved neighboring organs. He had performed the operation in seventeen cases without secondary ulcer or other unfavorable sequelæ. Downs, in 1917, asserted that he considered sleeve resection the ideal operation for hour-glass stomach if the pylorus is not stenosed. He reported five cases, in three of which the results were perfect. One patient continued to have trouble, and one died of pneu-

## RESECTION OF THE BODY OF THE STOMACH FOR ULCER

monia on the sixth day. Kloiber, in 1920, reported results following operation on eighteen patients who had been examined from two to four years afterward. Seventy-two and two-tenths per cent. were completely cured. Deaver and Reimann, in 1921, recommended the operation for large ulcers in the middle of the stomach or to the left of the middle, but advised gastro-enterostomy in addition. Wilensky, in 1921, said that the functional results of sleeve resection are quite superior to those of V-shaped excision, and recommended it for ulcers in or near the middle segment of the stomach. Lecène, in 1921, reported five cases in which operation had been performed from seven to eleven years previously. Three of the patients had not had symptoms after operation, and the other two had had slight symptoms lasting only a short time. De Quervain, in 1922, reported 90 per cent. of cures following his sleeve resections.

On the other hand, Faulhaber and Redwitz in 1914, in their experimental work, found, in every instance, constriction of the body of the stomach when healing was complete. Woolsey, in 1921, reported that his results with sleeve resection were not so good as with some other operations, but he thought this was to be expected because of the type of cases in which it had been employed. Moynihan, in 1920, mentioned that Billington had had poor results with sleeve resection, and, in 1921, he reported that the end-results were not satisfactory and he had not used the method for years. Moynihan also mentioned that Kümmel had ten cases in which hour-glass stomach had resulted. Von Schmieden, in 1921, recommended excision and reconstruction of the lesser curvature rather than sleeve resection.



FIG. 2.—(Case 94543.) Photograph of specimen showing multiple ulcers.

### RESULTS OBTAINED DURING A PERIOD OF FOURTEEN YEARS

From 1908 to 1922, ninety sleeve resections were performed in the Mayo Clinic: One for angioma, one for lymphosarcoma, thirty-two for carcinoma, and fifty-six for benign gastric ulcer (Table I). Since gastric ulcer occurs three times as often in men as in women, it is remarkable that these operations for ulcer were performed on thirty-seven women and nineteen men.

The patient with angioma on whom sleeve resection was performed is now alive and without gastric complaint two years after operation. The patient with lymphosarcoma died of recurrence ten months after operation.

In two of the thirty-two patients with carcinoma, it was necessary to resect the colon at the time of the sleeve resection; in one a gastro-enterostomy

was necessary and in one a pyloroplasty. In this group there were four operative deaths. This is a slight improvement on the average operative mortality from all resections of the stomach for carcinoma performed in the Clinic from 1897 to 1922. Two of the operative deaths were due to general peritonitis, and two to pneumonia. One of the patients who died from peritonitis also had a resection of the colon. Of the remaining twenty-eight patients

one could not be traced, and twelve are still living and without recurrence; three of these were operated on in 1921. The time since operation on the other nine living patients ranges from two years and seven months to nine years and eight months; in other words, 37 per cent. of the patients who survived

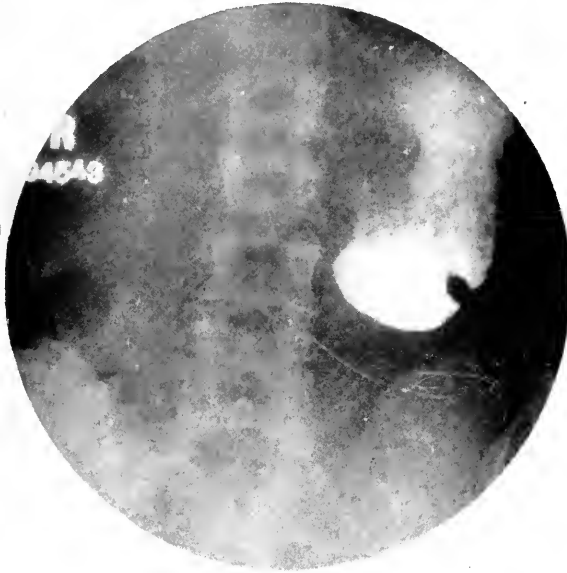


FIG. 3.—(Case 94543.) Three months after sleeve resection. Note slight contracture of the greater curvature at the line of anastomosis, not, properly speaking, hour-glass deformity.

TABLE I.  
*Sleeve Resections.*

	Men	Women	Average age, years
Angioma.....	1	.....	67
Lymphosarcoma.....	.....	1	30
Carcinoma.....	23	9	53
Ulcer.....	19	37	43

operation and who have been traced are alive and well at least two and one-half years after operation. The cause of death is not known of four of the fifteen patients who have died after leaving the Clinic; one died of uræmia and ten of recurrence. The length of life after operation in the latter group

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ranged from thirteen months to five years; the average twenty-seven months. None of the patients in whom glandular involvement was found at operation is alive (Table II).

TABLE II.  
*Sleeve Resections for Carcinoma; Thirty-two Cases.*

	Patients
Operative deaths . . . . .	4
No information . . . . .	1
Died from recurrence (from thirteen months to five years after operation, average time twenty-seven months) . .	10
Died from other causes . . . . .	5
Still living . . . . .	12
Total . . . . .	32

As a group the fifty-six patients on whom resections in continuity were performed because of benign ulcer represent serious surgical problems. Thirteen patients had single ulcers without perforation or hour-glass constriction; eighteen had single ulcers which had perforated; seven had single ulcers with hour-glass constriction; five had single ulcers which had perforated and caused hour-glass constriction; five had multiple ulcers without perforation or hour-glass constriction; five had multiple ulcers one or more of which had perforated, in three of these duodenal ulcers were also present, and three had multiple ulcers with hour-glass constrictions (Table III). In eight instances

TABLE III.  
*Type of Ulcer.*

	Patients
Single ulcer without perforation or hour-glass constriction . . . . .	13
Single perforated ulcer . . . . .	18
Single ulcer with hour-glass constriction . . . . .	7
Single ulcer with perforation and hour-glass constriction . . . . .	5
Multiple ulcers without perforation or hour-glass constriction . . . . .	5
Multiple ulcers with perforation . . . . .	5
Multiple ulcers with hour-glass constriction . . . . .	3
Total . . . . .	56

pyloroplasty was performed besides the sleeve resection, in one instance gastro-enterostomy, and in one resection of the colon and pyloroplasty.

In the group of patients having benign ulcer, there were three operative deaths. This is slightly higher than the average mortality (4 per cent.) in the cases of gastric ulcer in which operation was performed from 1906 to 1922, but the cases in which resection in continuity was performed represent much more serious surgical risks than the average cases of gastric ulcer. One of the operative deaths was due to hemorrhage, one to pneumonia, and one to peritonitis. A fourth patient died after leaving the Clinic. Four of

the fifty-six patients have been operated on less than one year. Of the remaining forty-eight patients, information has been obtained at least one year after operation from forty-one (85 per cent.). Fifteen of these patients report that they are completely relieved, and fourteen that they are relieved with the exception of some slight complaint; that is, 70 per cent. of the patients traced are cured. The percentage is undoubtedly higher than this, for if patients are having trouble, they are quite apt to answer questions with regard to their condition. These twenty-nine cures include three eight-year, one



FIG. 4.—(Case 94543.) Six months after sleeve resection. The stomach has increased greatly in size.

seven-year, two six-year, four five-year, nine four-year, two three-year, three two-year cures and five between one and two years. The length of time between operation and the last report averages four years.

Six (14 per cent.) of the forty-one patients traced reported that they were improved by the operation, but that they did not consider themselves cured. Six patients reported that the operation was not satisfactory. One said that he had had no relief from the operation. One patient returned six years after

operation and a diagnosis was made of recurring ulcer. One patient had had a gastro-enterostomy fifteen years before the sleeve resection without relief. Ten months after the sleeve resection, she began to have severe epigastric pain and vomited. Five months later, exploration was performed at the Clinic and a gastrojejunal ulcer found. There was no contraction at the site of the sleeve resection. The gastrojejunal ulcer was excised, the gastro-enterostomy cut off, and a pyloroplasty made. Eighteen months afterward, the patient reported that she was almost completely relieved, but four years afterward, that she was having just as much trouble as before the operation. Complete examination of the stomach at this time, including röntgenograms, was negative. On three of the six patients whose operation had not been satisfactory it was necessary to perform gastro-enterostomy later. In one instance the operation was performed one year after the sleeve resection, because of an ulcer in the suture line on the lesser curvature. In one an anterior gastro-enterostomy was performed one year



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after the sleeve resection because of adhesions to the liver and pancreas with obstruction, and in one a posterior gastro-enterostomy was performed five years after sleeve resection because of obstruction in the vicinity of the pyloroplasty, which was made at the time of the sleeve resection. The poor result in this case may have been due to the pyloroplasty. Thus, 70 per cent. of the patients are cured and 14 per cent. improved and 14 per cent. report unsatisfactory results (Table IV). These percentages compare favorably with

TABLE IV.  
*Sleeve Resections for Ulcer.*

	Patients
Operative deaths.....	3
Deaths since leaving the Clinic.....	1
Operation less than one year.....	4
Not traced.....	7
Cured by operation.....	29
Improved by operation.....	6
Operation unsatisfactory.....	6
Total.....	56

the results obtained in calloused ulcer of the posterior wall treated by excision and gastro-enterostomy, namely, 60.8 per cent. cured, 32.5 per cent. relieved, and 6.9 per cent. unimproved.

Fifteen patients were examined by the Röntgen-ray at periods varying from one month to six years after operation. The stomach was found to be practically normal in shape, size, and position. In five (33 per cent.) there was a slight hour-glass constriction, corresponding to the site of resection. We had occasion to explore six patients who had had sleeve resections from one to five years previously. In five of these röntgenograms had shown constriction at the site of anastomosis, but at operation no such narrowing could be found in any of the six cases. The shadow seen in the röntgenograms in the five cases was probably scar contraction, or spasm. Such spasm is relaxed by anæsthesia, which would account for the absence of the constriction at exploration.

The death rate in the first four years after operation for duodenal ulcer is practically normal, while after operation for gastric ulcer it is three times normal. W. J. Mayo has pointed out that some of the patients believed to have gastric ulcer must have had gastric cancer. In any large series of excisions of gastric ulcer, some of the patients will probably develop cancer of the stomach. So far as we know, none of our patients has developed gastric cancer following resection in continuity for benign ulcer, but in ten instances following other forms of excision second operation revealed cancer.

### INDICATIONS FOR SLEEVE RESECTION

Cases in which sleeve resection had been performed were studied for the purpose of determining the immediate and ultimate results of this operation as compared with others. It is apparent that this type of operation is not

suitable for all cases; however, we believe it is the operation of choice in certain cases, and in view of the fact that favorable results were obtained in our series, we are inclined to believe that it can be employed to advantage more often than formerly. While gastro-enterostomy is usually all that is necessary in cases of duodenal ulcer, it is not sufficient in gastric ulcers for two reasons: First, the lesion in the stomach, although apparently benign,



FIG. 5.—(Case 222404.) Gastric ulcer. Hour-glass stomach.

may be malignant, and therefore must be removed or destroyed. Second, it is known that simple V-excision of a gastric ulcer may, at times, interfere with peristalsis and result in almost complete retention. Therefore, as a rule, it is necessary to make a gastro-enterostomy and cauterize or excise the ulcer, too. This plan is probably the better one to follow in most cases, although there are certain times when, as a result of the V-excision of the ulcer and closure of the opening, a very marked deformity is produced in the contour of the stomach. This is more likely to occur when the ulcer is large and is on the posterior wall, and particularly if the lesion is in the cardiac end of the stomach. We believe that the lesion is more likely to be removed thoroughly by sleeve resection than by excision. It is not always possible to determine the character of the ulcer at the time of its removal, and if it is malignant the sleeve resection would seem to be the more logical procedure. If the lesion is on the cardiac side it is apparent that the main part of the stomach will be on the pyloric side, so that any operation which would remove the pylorus would necessarily remove the larger part of the stomach. Preservation of this part of the stomach does not seem to favor recurrence. In none of our patients, so far as we know, did malignancy occur in this portion of the stomach.

In cases in which the ulcer is large, indurated, and in the central or

may be malignant, and therefore must be removed or destroyed. Second, it is known that simple V-excision of a gastric ulcer may, at times, interfere with peristalsis and result in almost complete retention. Therefore, as a rule, it is necessary to make a gastro-enterostomy and cauterize or excise the ulcer, too. This plan is probably the better one to follow in most cases, although there are certain times when, as a result of the V-excision of the ulcer and closure of the opening, a very marked deformity is produced in the contour of

cardiac third of the stomach, a sleeve resection can be performed with less technical difficulty than excision and gastro-enterostomy, or any other form of resection, except the Balfour cautery operation. There is less actual operating than in any other procedure and usually the technical steps can be carried out more accurately. The stomach is so well supplied with vessels and nerves from each side, that almost any part or quadrant can be removed with the assurance that the repair will heal without difficulty. In none of our cases was there necrosis of the gastric wall or giving way of the suture line. In some of the cases the open end in one segment of the stomach was at least twice the diameter of the opposite segment, and it was necessary to plan the anastomosis to make these join properly, yet the healing was not interfered with. If the lesion is near the pylorus, the result of this type of excision may not be so satisfactory. In a few of our cases in which the stomach was removed almost to the pylorus, it was necessary later to make a gastro-enterostomy. In some instances, the resection was practically a Billroth

No. 1; in others, an attempt was made to enlarge the pylorus by performing a plastic operation as well as a resection. In some of these the results were satisfactory, in others the stomach did not function properly. It is possible that with technical changes, operations of this type may be made more suitable for pyloric lesions.

The principal objections to sleeve resection are that it removes too much of the unaffected gastric wall, and that it is often followed by contraction which results in hour-glass deformity. If the tumor is malignant there can be no objection to wide excision of the lesion, but if it is benign as much good tissue should be preserved as is compatible with good results. For this reason we believe it is best not to employ the procedure for small ulcers. If the ulcer is large the deformity will often be less following a sleeve resection than following excision and gastro-enterostomy



FIG. 6.—(Case 222404.) Stomach four years after sleeve resection. Considered normal röntgenologically.

We have been impressed with the extremely good functional end results in our series of cases. In some cases there seems to be a contraction at the site of the union. As time passes we are having opportunities to examine these patients at longer intervals after operation, and our findings indicate that the objection to sleeve resection has been exaggerated. We are even doubtful in some instances if the contraction sometimes seen in the röntgenograms is a real deformity, or that it interferes with the normal function of the stomach. In any event, in no other group of cases have we had better functional results (Figs. 1-8).

#### DISCUSSION OF TECHNIC

The first technical step in the operation consists of separating the lesion from the surrounding structures. Often the lesion is attached to the pancreas,



FIG. 7.—(Case 353745.) One year after sleeve resection. No evidence of recurrence. Normal röntgenologically.

a small piece of which may be excised with the lesion. We have done this in a number of instances with apparently no ill effect. In certain cases it is best to divide the stomach above or below the lesion before dissecting it free.

After the stomach has been freed, the gastrohepatic omentum is dissected away from the lesser curvature for a sufficient space and the gastrocolic omentum is separated from the greater curvature, the

amount of separation will depend on the location and suspected character of the lesion.

The area to be removed is clamped between two large Payr clamps. Rubber-guarded clamps are used to prevent soiling from the gastric contents as the segment is cut away with the cautery. These clamps are then put on each segment of stomach just beyond the large crushing clamps which are then removed and the two segments joined. Two rows of catgut sutures are used to approximate the mucous membrane, the muscularis, and the peritoneal layers, and the anastomosis is completed by one row of interrupted silk sutures. The angles at the lesser and greater curvatures are supported by suturing the several parts of the severed omentum over them.

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### CONCLUSIONS

In cases of carcinoma of the stomach, the results from sleeve resection are as satisfactory as from any other form of operation.

Sleeve resection is well suited for some ulcers high on the body of the stomach, for large perforated ulcers, and for multiple ulcers. It is the ideal procedure in hour-glass stomachs.



FIG. 8.—(Case 249122.) Hour-glass stomach. Ulcer and hour-glass at operation; sleeve resection. Röntgenogram two years later showed a normal stomach.

The danger of hour-glass constriction following sleeve resection has been exaggerated.

The functional results of this operation are very satisfactory.

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## NOTE OF CORRECTION

T. WINGATE TODD. BONY FEATURES OF POSTERIOR CONGENITAL  
DISLOCATION OF THE SHOULDER

Erratum. *ANNALS OF SURGERY*, July number 1922, pp. 70-76. The legend for figure 1 has erroneously been attached to figure 2 (No. 635) and the legend for figure 2 has been attached to figure 1 (No. 363).

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## THE SIGNIFICANCE OF BACTERIA IN THE BLOOD STREAM FROM A SURGICAL STANDPOINT\*

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SEVERAL years ago I heard a bacteriologist complaining that a certain clinician was asking for blood cultures in nearly all his patients, that the laboratory was being called on for much futile work and much unnecessary expense and that nine-tenths of the examinations yielded information of little or no value, either practically or scientifically.

Since then, whenever a blood culture has been taken in the surgical wards I have asked the purpose of the examination. I have especially inquired of the internes in the hospital what a bacteræmia signified. They have, for the most part, answered that a bacteræmia meant that the bacteria were simply being transported by the blood stream, but that a septicæmia meant that they were growing and multiplying in the circulating blood. Though this answer, which is in accord with the teachings of Wassermann<sup>1</sup> and others of the older masters of bacteriology, could throw no light on the case under discussion, its utterance seemed to give satisfaction.

If we make such a distinction between bacteræmia and septicæmia we are in difficulties. We exclude, probably, all the cases of subacute and chronic sepsis and possibly even the early stages of acute sepsis. It is well recognized to-day that the bacteria in many of these cases are being unloaded into the blood stream from a focus of infection directly communicating with the circulating blood. For example, in septic endocarditis bacteria are constantly passing into the blood stream from the focus on the heart valves and there are numerous cases grouped clinically as septicæmia in which pathogenic bacteria, like the hæmolytic streptococcus, have been repeatedly isolated from the circulating blood and in which recoveries are reported as soon as a definite nidus of infection has been removed or shut off from the blood stream. It has also been shown that the serum and leucocytes of patients suffering from subacute and chronic septicæmia possess powerful opsonic action against the organisms causing the infection.<sup>2</sup> The bacteria invading the circulating blood are being disposed of there. The microörganisms are not multiplying

\* Read before the American Surgical Association, May 1, 1922.

in the blood, but are being poured into the blood. They are being destroyed time after time by the various bactericidal agents of blood serum and body cells.

In the first edition of Zinsser's *Bacteriology*, 1915,<sup>3</sup> bacteræmia and septicæmia are used as synonymous. In his last edition, 1922, he amplifies the same idea<sup>4</sup>: "It is an important thing to remember that in all of these septicæmias the presence of the organisms in the blood may not signify that they are actually multiplying in the blood. It is, in our opinion, more likely that the organisms at first simply enter the blood stream from the lesion and are destroyed in the circulation." I think this is the sense in which septicæmia is generally used to-day. It is so used in most of the cases reported as septicæmia in current scientific papers. In an interesting paper by Anderson and Richardson,<sup>5</sup> in the *British Journal of Surgery*, 1918, it is used in this sense. Dehelly's<sup>6</sup> opening sentence in a case report is: "One speaks of septicæmia when it is possible to determine by culture the presence of living bacteria in the blood," and the title of a paper by Graham,<sup>7</sup> in 1916, is: "A Case of Anthrax Septicæmia with Recovery." The only evidence of septicæmia was a single culture showing anthrax bacilli in the circulating blood.

If bacteria of moderate virulence are injected into the veins of a resistant animal, they disappear completely from the circulation in a very short time. Undoubtedly many such bacterial invasions occur in human beings and pass unappreciated. Every hæmatogenous osteomyelitis presupposes a contamination of the blood by microorganisms. It is conceivable that blood cultures might chance to be taken during one of these showers and a bacteræmia would be reported which could hardly be termed a septicæmia; but confusion from this source is avoided if the word bacteræmia is qualified by the words persistent, intermittent or occasional. With this conception of bacteræmia in mind, I have looked over the case histories of patients showing positive blood cultures in St. Luke's Hospital for the last six years, thinking it might be of interest to study the relation of the finding of bacteria in the circulating blood to prognosis, to the focus of infection, to clinical manifestations, etc.

A large percentage of negative blood cultures are always found in any series grouped clinically as sepsis. The size of this group depends on the aim and the astuteness of the clinician, as well as on the technic of the bacteriologist. On the aim, because, if an attempt is made to find bacteræmia in patients with focal lesions, with intermittent septic symptoms, bacteria-free intervals are frequent. On the astuteness, because there is a definite relation between symptoms and the time bacteria are likely to be found. If we select well recognized, far advanced cases of sepsis and make cultures only shortly before death, the percentage of failures will be low.

There have been 496 blood cultures taken. Of these seventy-seven were positive, or about fifteen per cent. During the last year, twenty-three per cent. of the cultures were positive. During the last year on the surgical service at the Presbyterian Hospital there have been 175 blood cultures taken; of these sixty-six, or thirty-seven per cent., were positive.



It is safe to say that a single blood culture taken by itself is of little or no value in prognosis. When Lenhartz<sup>8</sup> wrote, nineteen years ago: "It must be strongly emphasized that it is not necessary to be too hopeless when pathogenic germs are found in the circulating blood, for I have seen even a patient with staphylococcus sepsis with high fever recover, as well as twelve patients with pneumomycosis, several patients with streptococcus sepsis and two with sepsis from bacterium coli "if pathogenic organisms were found in the living blood the condition was regarded as nearly hopeless. I remember talking to a bacteriologist about fourteen or fifteen years ago and hearing him express his surprise that a patient in whom he had found hæmolytic streptococci in the blood had recovered. I remember the scorn with which another bacteriologist spoke of the ignorance of surgeons when we asked him about the prognosis of a case of anthrax in which he had found organisms in the blood stream. The outcome in any given case depends on the number and virulence of bacteria, the resistance of the host and the focal lesion. For example, in our series all nine patients with pneumococcus bacteraemia died. This in no sense represents the mortality in blood stream infection by the pneumococcus. A number of factors must also be considered; one patient had an undrained lung abscess, six had terminal pneumonias following other surgical conditions, two had general pneumococcus peritonitis. Lenhartz (*l. c.*) reported that in twenty-six patients with pneumococci in the blood, twelve recovered and fourteen died. The Presbyterian Hospital statistics show six deaths and two recoveries. An attempt might be made to base an opinion on the number of colonies found in the blood cultures. It is self-evident that a single colony found on a single plate must have a different significance from hundreds of colonies found on every plate, but only by repeated examinations and a comparison of a number of similar cases can an indication be given regarding prognosis. Such an attempt has been made by Sutton and Sevier<sup>9</sup> in pneumonias. It is well known that in far advanced septic conditions the blood stream is swarming with microorganisms and that at autopsy in such cases organisms may be cultivated from the heart's blood and various organs. The old conception of septicæmia was concerned largely with this condition. The whole question is enormously complicated by variations in virulence in the different strains and the intermittent contamination of the blood stream.

Our series of streptococcus infections furnish an interesting study from another standpoint. There are thirty-seven case reports with a mortality of sixty-two per cent. If we consider separately the cases in which the primary focus of infection was the middle ear, there are ten recoveries and three deaths, or a mortality of twenty-three per cent. In the ten patients that recovered, eight had the jugular ligated immediately after the streptococci were detected in the blood. There were two patients that recovered without ligation; in one there was only a single culture showing one colony. Two patients were very ill with a high temperature when they entered the hospital. Blood cultures showed in both, at the time of operation or before, hæmolytic

streptococci in the blood stream. Their recovery is a striking example of cutting off the source of infection and so stopping the bacteraemia. An observation of Dehelly (*l. c.*) in this connection is interesting. He amputated the leg of a fireman for an infected compound fracture. The patient continued ill and repeated examination showed hæmolytic streptococci in the blood. He reamputated through the thigh. The patient promptly recovered. Thereafter the blood cultures were negative. A most painstaking examination of the amputated stump showed a suppurative thrombophlebitis of a single vein.

In the other six cases, the course from a bacteriological point of view is equally interesting. The patients evidently had a simple mastoiditis, either acute or chronic; several had little or no fever. There was no thought of sinus infection, no blood cultures were taken, a simple or complete mastoid operation, as it is termed, was performed. In each instance there was a sharp temperature reaction following the operation and on the fifth to the eighth day there was a sudden rise in temperature, often accompanied by a chill. Blood cultures were immediately taken and on the following day, when positive cultures were obtained, a second operation was performed and the jugular tied and excised.

The following observation on a patient on whom I operated two years ago for chronic empyema has a similar significance.

The patient was eighteen years old, white and obese. Nine months before he had an operation for metapneumonic empyema. After three months the empyema wound healed but in a few weeks he became ill and the wound was reopened. It had remained in this condition up to the time of admission, opening and discharging for a few weeks and then closing again. On admission to the hospital his temperature was 99. He was not seriously ill. Under gas-oxygen anaesthesia the old scar was removed and a small cavity containing flabby, unhealthy granulations was exposed; there was no free pus. A portion of the thoracic wall overlying the cavity was removed, the wound closed and a large rubber tube left in the angle for drainage. His temperature following the operation was 104, the next day it was 107, he had several chills. Several days later a blood culture showed hæmolytic streptococci. During this period there was no change in the appearance of the wound, there was no retention of wound discharges, there was no redness or swelling of the surrounding skin. Two or three weeks later he developed a phlebitis in the femoral veins and later severe pain in the hip. He recovered.

It is difficult not to believe that the bacteraemia and the accompanying clinical manifestations of septicæmia were coincident with the operation in all these cases.

Anderson and Richardson (*l. c.*) give an example of mild streptococcus sepsis following a gunshot injury in which the infected wound had a similar appearance to that reported in the last case.

"There were two wounds in the thigh, each the size of a florin and extending through the deep fascia into the superficial layers of the subjacent muscle-wounds in which the drainage was perfect, in which there was no retention of

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discharges, the tissues about the wound were soft and painless. A streptococcus was isolated from the blood, the blood then became sterile and the patient appeared to be in normal health for about six days. There was a rise of temperature to 103 and streptococci were again isolated from the blood." This patient also recovered.

It is interesting in both these cases to note that bacteria were entering the blood stream, although there was no evidence of retention of discharges or tension in the tissues.

In the staphylococcus blood stream infections there were twelve recoveries and fourteen deaths. Of the patients that recovered four had osteomyelitis; in three of these there were multiple foci. One of these patients had been operated on for osteomyelitis of the humerus following a mastoid operation when eleven years old. After two years the wound healed and the girl remained well for seven years. Then she had a high temperature and severe pain in the arm. At operation pus was found in the medullary cavity of the humerus, beneath the old scar. Before operation her temperature range was from 99 to 102°, following operation from 102 to 105°. A blood culture taken at this time showed staphylococcus. Here again the bacteræmia seemed to follow definitely the operative interference.

The jarring of an infected bone with hammer and chisel may well dislodge small infected emboli. In the area about every active focus of infection, capillaries, and often small veins, are thrombosed, and many of these thrombi are doubtless infected. Is it not probable that some of these minute infected thrombi are set free? In many instances the jarring may not only loosen thrombi but may break down the protective cellular barrier and cause a progressive, infective thrombophlebitis. Finally the infected thrombus reaches a large trunk and portions of it are swept away into the circulation.

There were seven patients with infections of the lips. Two recovered and five died. Another patient died with staphylococci in the blood stream following the incision of a furuncle on the back. It is often said, and it has been confirmed by experience, that infection is spread, probably through the lymphatics, if incision is made in the indurated and inflamed tissues before there is a definite, visible focal point. I believe cutting through tissues with a sharp knife can do little damage. It is by poking and pressing the wound and thrusting blunt instruments into the inflamed tissues that the damage is done, and I believe that the greatest danger lies, not in the spread through the lymphatics, but in the dislodgment of infected thrombi and the progressive thrombophlebitis of the minute veins set up by these manipulations. An observation made many years ago by Reverdin<sup>10</sup> throws much light on this subject. He dissected out the veins in the body of a patient who had died of general sepsis following an infection of the lip. The jugular was normal, there was a small infected clot, however, projecting into its lumen from one of the tributary veins, and this vein was traced back to the infected focus. The blood stream hurrying by had swept away, from time to time, bacteria

and small portions of infected clot. I believe such infected clots in even the smaller veins are responsible for many of the blood stream infections.

There were six cases recorded of bacteraemia when the port of entry seemed to be the peritoneum; one with *bacillus coli communis*, two with *pneumococcus*, three with *streptococcus*. Of these one patient only recovered. In this patient an operation was performed through an intermuscular incision for acute appendicitis. The appendix wall was found thick and the vessels congested; there was no exudate in the peritoneal cavity and no adhesions; the wound was closed without drainage. The blood count on admission had been 18,500 white blood cells, the temperature on admission was  $101.2^{\circ}$ . On the day following the operation the temperature was  $105.4^{\circ}$  and remained for two days from  $104$  to  $105^{\circ}$ . The wound was then reopened. On opening the peritoneum a purulent exudate escaped. The stump of the appendix was inspected and found in good condition; a drainage tube was introduced. The temperature fell after the second operation, remaining between  $100$  and  $103^{\circ}$  for five weeks and then fell to normal. Two days after the second operation blood cultures showed hæmolytic streptococci, eight days later the culture was negative, but two weeks later they were again isolated from the blood stream. She finally recovered and left the hospital two months after admission. The intermittent bacteraemia, the sudden clinical evidence of blood infection following operation, are similar to observations already made. Rapid absorption of bacteria from the peritoneum has long been recognized, so that death may occur from blood infections with little or no reaction on the part of the peritoneum. But this case of chronic streptococcus bacteraemia suggests that from time to time bacteria may pass from the peritoneum into the blood, very much as they would enter from a focus directly communicating with a vein. This observation is not in accord with the generally accepted view based on the experiments of Noetzel,<sup>11</sup> that in an inflamed peritoneum the absorption of bacteria does not take place. Is it possible in this instance that a small infected, thrombosed vein was discharging streptococci into the blood stream and that the patient was suffering not only from the toxæmia from the infected peritoneum, but also from a streptococcus bacteraemia from a thrombophlebitis?

In studying the records of cases in which positive cultures are found, it is a very simple matter to arrange them by percentages of recovery and death, metastases, types of organisms, port of entry, main lesions, etc. But a little reflection shows that such a percentage study is of little value; too many concomitant factors are omitted, the number of cultures from each case is insufficient, the number and virulence of the organisms is rarely recorded. Taken, however, with the clinical records, one can reconstruct and surmise the sequence of events to a certain extent. It is the surmises and reflections furnished by such reconstruction that I have attempted to present, I am aware, very imperfectly.

From a practical surgical standpoint a persistent bacteraemia suggests a focus of infection directly communicating with the blood current, even if

## BACTERIA IN THE BLOOD STREAM

there are no signs of tissue tension or pent-up wound discharges. It by no means inevitably suggests a hopeless septicæmia, and although a single culture, divorced from clinical observation, is of little help in making a prognosis, still, for the scientific study of infection, etc., for the investigation of the relation of bacterial discharge into the blood to tissue tension, for the study of generalized infections following operations in infected areas and for the study of the relation of the clinical manifestations to the bacterial invasions, it is of the greatest value, and I would urge an intensive study of a few cases rather than the haphazard examination of many cases. It is well to keep in mind that it is impossible to-day to classify bacteria with absolute scientific accuracy, and that the various names given are group names. Differentiation has taken place during the countless ages in which bacteria have been dividing and subdividing on the earth, to a small extent morphological. At least in a morphology we can appreciate, but differences show themselves rather in subtle reactions to surrounding media and in the elaboration of most complex chemical compounds.

I wish to express my thanks to Doctor Wood for allowing me to study the laboratory records at St. Luke's Hospital and to Doctor Whipple for his courtesy in giving me the statistics for the year 1921 from the Presbyterian Hospital.

### ST. LUKE'S HOSPITAL SERIES

*Recoveries—28*

*Deaths—49*

#### I.A. *Streptococcus Bacteræmia Recoveries—14*

Diagnosis	Operation
1. Cellulitis of Hand and Forearm, Suppurative Tenosynovitis	Incision and Drainage Amputation of Little Finger
2. Chronic Empyema, Recurrent Thoracic Fistula	Thoracoplasty
3. Acute Appendicitis, Peritonitis	Appendectomy with Drainage
4. Incomplete Abortion	Curettage
5. Acute Mastoiditis	Mastoidectomy, Resection of Jugular
6. Acute Mastoiditis	Mastoidectomy
7. Acute Mastoiditis, Sinus Thrombosis	Mastoidectomy, Resection of Jugular
8. Acute Mastoiditis Sinus Thrombosis	Mastoidectomy
9. Double Mastoiditis	Mastoidectomy
10. Chronic Otitis Media	Mastoidectomy, Resection of Jugular
11. Acute Otitis Media, Sinus Thrombosis	Mastoidectomy, Resection of Jugular
12. Double Otitis Media	Mastoidectomy
13. Acute Otitis Media, Sinus Thrombosis	Mastoidectomy, Resection of Jugular
14. Otitis Media, Sinus Thrombosis	Mastoidectomy, Resection of Jugular

# WALTON MARTIN

## I.B. *Streptococcus Bacteræmia Deaths*—23

Diagnosis	Operation
1. Otitis Media, Mastoiditis, Sinus Thrombosis	Mastoidectomy, Ligation of Internal Jugular
2. Otitis Media, Sinus Thrombosis, Diabetes Mellitus	Mastoidectomy
3. Acute Otitis Media, Sinus Thrombosis, Pneumococcus, Meningitis	No Operation
4. Mastoiditis	Mastoidectomy, Ligation of Internal Jugular, Opening Lateral Sinus
5. Acute Mastoiditis, Sinus Thrombosis	Mastoidectomy, Sinusectomy with Resection of Jugular
6. Empyema	Thoracotomy
7. Empyema	Thoracotomy
8. Carbuncle of Neck	Excision of Necrotic Tissue
9. Lobar Pneumonia	No Operation
10. Cellulitis of Toe	No Operation
(Treated by Chiropodist for ingrowing toe nail, slight redness about toe nail.)	
11. Septic Uterus, General Peritonitis	No Operation
12. General Peritonitis	Appendectomy
(Appendix normal. Exudate in peritoneum at time of operation showed streptococcus viridans. Blood culture 3 days later showed streptococcus viridans.)	
13. Infected Adeno-Fibroma of Breast	Mastectomy
14. Incarcerated Ventral Hernia, Infection of Wound	Reduction, Plastic Repair
15. Hypertrophy of Prostate	Prostatectomy
16. Urethral Stricture	Urethrotomy
17. Infected Tenosynovitis and Cellulitis	Incision and Drainage
18. Acute Cervical Adenitis	No Operation
(Tonsils removed one week before admission.)	
19. Popliteal Abscess	Incision and Drainage
20. Ludwigs Angina	Incision and Drainage, Tracheotomy
21. Infected Lacerated Wound of Arm	Amputation of Arm
22. Cerebrospinal Meningitis, Retro-pharyngeal Abscess	No Operation
23. Cellulitis of Foot, Diabetic Gangrene of Toe	Incision and Drainage

## II.A. *Staphylococcus Bacteræmia Recoveries*—12.

Diagnosis	Operation
1. Double Otitis Media	Mastoidectomy
2. Carbuncle of Lip	Incision & Drainage
3. Chronic Otitis Media	Mastoidectomy
4. Uterine Fibromyoma	Supra-Vaginal Hysterectomy, Dilatation and Curettage

## BACTERIA IN THE BLOOD STREAM

Diagnosis	Operation
5. Carbuncle of Lip	Incision and Drainage
6. Acute Olecranon Bursitis, Osteomyelitis of Femur	Incision and Drainage
7. Scrotal Abscess	Incision and Drainage
8. Multiple Abscesses of Back and Shoulder	Incision
9. Osteomyelitis of Humerus	Curettage
10. Osteomyelitis of Tibia	Incision and Drainage
11. Osteomyelitis of Fibula	Incision, Curettage and Drainage
12. Osteomyelitis of Humerus Tibia, Femur and Occipital Bone	Amputation of Arm

### II.B. *Staphylococcus Bacteræmia Deaths*—14

Diagnosis	Operation
1. Furuncle of Nose	Dressings, Medical Treatment
2. Abscess of Liver	Exploratory Laparotomy, Thoracotomy, Drainage of Abscess
3. Osteomyelitis, Meningitis, Metastatic Abscess	Incision of Abscess, Osteotomy
4. Arteriosclerotic and Diabetic Gangrene of Foot	Amputation Through Upper Third
5. Chronic Otitis Media, Cerebro-spinal Meningitis	Mastoidectomy
6. Cellulitis of Nose and Face	No Operation
7. Osteomyelitis of Arm	No Operation
8. Furunculosis	No Operation
9. Inguinal Adenitis	Incision and Drainage
10. Osteomyelitis of Tibia	Incision and Drainage
11. General Septicæmia	No Operation
12. Carbuncle of Face	Incision and Drainage
13. Bilateral Pyelonephrosis, Cystitis	No Operation
14. Cellulitis of Upper Lip, Cavernous Sinus Thrombosis	Incision and Drainage

### III. *Pneumococcus Bacteræmia Deaths*—9

Diagnosis	Operation
1. Abscess of Lung	Incision and Drainage
2. Pan-Ophthalmitis	Evisceration of Eye
3. Abscess of Neck	Incision and Drainage
4. Acute Mastoiditis	Mastoidectomy
5. Otitis Media	No Operation
6. Double Otitis Media	Mastoidectomy
7. Double Mastoiditis	Mastoidectomy
8. Peritonitis	Laparotomy with Drainage
9. Peritonitis	Laparotomy with Drainage Appendicectomy

# WALTON MARTIN

## IV. *Bacillus Coli Communis* Deaths—3

Diagnosis	Operation
1. Hypernephroma	Nephrectomy
2. Acute Appendicitis	Appendicectomy
3. Cholecystitis, Multiple Abscesses of Liver	Cholecystectomy

## V. *Paratyphoid* Recoveries—1.

Diagnosis	Operation
1. Retroversion, Hemorrhoids	Suspension, Hemorrhoidectomy, Appendicectomy

## VI. *Typhoid* Recoveries—1.

Diagnosis	Operation
1. Typhoid Fever	No Operation

### PRESBYTERIAN HOSPITAL SERIES

#### *Recoveries*—48

#### *Deaths*—37

#### I. *Streptococcus Bacteræmia* Recoveries—19

#### *Deaths*—13

Diagnosis	Recoveries	Deaths
Osteomyelitis .....	2	0
Suppurative Arthritis .....	4	2
Empyema .....	3	1
Hand Infection .....	1	1
Peritonsillar Abscess .....	0	1
Incomplete Abortion .....	2	0
Cellulitis .....	5	1
Suppurative Thrombophlebitis .....	1	3
Mastoiditis .....	1	2
Meningitis .....	0	2

#### II. *Staphylococcus Bacteræmia* Recoveries—13

#### *Deaths*—16

Diagnosis	Recoveries	Deaths
Carbuncles .....	5	7
Suppurative Arthritis .....	3	3
Hand Infections .....	1	2
Peritonitis .....	0	2
Cellulitis .....	2	1
Suppurative Nephritis .....	1	0
Suppurative Thrombophlebitis .....	1	1

#### III. *Pneumococcus Bacteræmia* Recoveries—11

#### *Deaths*—3

Diagnosis	Recoveries	Deaths
Osteomyelitis .....	0	1
Suppurative Arthritis .....	2	0
Empyema .....	8	0
Peritonitis .....	1	1
Meningitis .....	0	1



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### IV. *Bacillus Coli* Recoveries—5

Deaths—3

Diagnosis	Recoveries	Deaths
Peritonitis .....	1	1
Incomplete Abortion .....	0	1
Cholecystitis .....	2	0
Suppurative Nephritis .....	1	1
Suppurative Thrombophlebitis .....	1	0

### V. *Bacillus Proteus* Recoveries—0

Deaths—1

Diagnosis	Recoveries	Deaths
Suppurative Thrombophlebitis .....	0	1

### VI. *Bacillus Aerogenes* Recoveries—0

Deaths—1

Diagnosis	Recoveries	Deaths
Cellulitis .....	0	1

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## THE PERITONEAL MANIFESTATIONS OF CHRONIC MULTIPLE SEROSITIS, CONCATO'S DISEASE\*

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ROKITANSKY, the great Bohemian pathologic anatomist, in 1842, described the post-mortem examination of a patient who had died from asthenia. There were found chronic inflammation and partial obliteration of the great serous sacs in the thoracic and abdominal cavities, almost complete obliteration of the pleural sacs, and complete obliteration of the pericardial sac, the result of an antecedent pleuritis and pericarditis. Because of the chronic hypertrophic peritonitis, the liver and spleen had become incased in adhesions, and the small intestines were locked together although they were not locally obstructed. There was a large quantity of fluid in the peritoneal cavity, but no oedema of the lower extremities.

Van Deen, in 1846, gave a clinical description of this pathologic condition, describing the syndrome which is now called multiple serositis. In 1875, Hilton Fagge, one of the most learned physicians of his time gave an excellent description of the disease, reporting in detail cases seen in Guy's Hospital. Curschmann, in 1884, described one phase of the disease under the title, chronic hyperplastic perihepatitis or "iced liver." The phase considered by Curschmann, however, had been described previously by Wilks and Moxon as early as 1875. Comparatively little attention was paid to multiple serositis until 1896, when Pick reported three cases, describing not only the pathologic conditions but summarizing the clinical symptoms. His work was so well done with regard to the pericarditis that this manifestation was given the name of Pick's disease. Pick became obsessed with the idea that the disease was primarily an affection of the pericardium, that the lesions in the pleural and peritoneal cavities were the result of interference with the action of the heart, and that the ascites, so characteristic of these cases, was secondary to the venous engorgement of the liver. Concato, in 1881, gave a most convincing description of the peritoneal manifestations of this curious disease, so that it is sometimes referred to, especially by the Italians who have done much good work on the subject, as Concato's disease. Picchini, in 1901, published an especially interesting paper in which he reported 110 cases, fifty of which were his own. Osler, who was one of the first to recognize the condition, gave it a place in American literature in 1896. His description was followed by papers by Cabot in 1898 and by Herrick in 1902. At that time the disease was considered a rare and unique condition, known to students of pathologic

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anatomy, but seldom recognized clinically. Kelly, in 1903, in a remarkable monograph reviewed the literature to date, and ably discussed the various features of the disease. Since then very little other than corroborative data have been contributed, although excellent papers have appeared by Evans, in 1918, and by Reid, in 1920. However, a large number of cases has been reported which have not as yet been indexed in the literature.

My attention was drawn to multiple serositis more than twenty years ago when I was trying to fathom the cause of an ascites which had been diagnosed as the result of tuberculous peritonitis or cirrhosis of the liver. The patient was explored, after the ascitic accumulation had been evacuated; the peritoneum was enormously thickened and glistening white and bore little or no resemblance to that seen in cases of tuberculous peritonitis or in cases of ascites due to cirrhosis of the liver. The liver was buried in a mass of adhesions, and on cutting through them, the substance of the liver was found normal, although deformed from external pressure. A second similar case was seen some months later in which, besides the appearance described, the area of the small intestines was surrounded by a sheath of thickened peritoneum which bound the intestines down to the spine, and resembled the flattened crown of a derby hat. In both cases an enormous amount of ascitic fluid was present. The pericardial and pleural manifestations of the disease were not recognized, yet it was significant that the first patient gave evidence of a weak heart and that there was some fluid in the chest cavities. It was not until the publication of Kelly's article in 1903, however, that I recognized these two cases as examples of multiple serositis. Since that time we have seen other typical cases.

In reviewing the literature and reports of cases of multiple serositis, it is seen that the symptoms of the disease vary according to the serous cavity which is most extensively involved. When pericardial adhesions causing a crippled heart are more prominent than the pleural and peritoneal manifestations, the latter may be overlooked. In the greater number of cases the ascites is the most prominent feature of the disease and is usually attributed to cirrhosis of the liver or so-called pseudocirrhosis. Evacuation of the ascitic fluid is followed by reaccumulation, although in the course of time this may cease. The amount of fluid removed by successive tapplings in the course of years has been enormous in these cases. Osler describes the case of a child tapped 121 times; Rumpf's patient was tapped 301 times. In one reported case more than 600 gallons of ascitic fluid were removed within five years; the patient remained in fair health until shortly before death. The ascitic fluid is clear and straw-colored with about 3 per cent. of albumin which consigns it to the class of inflammatory exudates.

One has but to read the titles of articles concerning the disease to note the development of knowledge of a condition very general in character. Not only are the cases cited dissimilar in many respects but the pathologic picture varies greatly; in one case obliteration of the pericardial sac is the

noticeable feature, in another obliteration of the pleural sacs. The condition in the peritoneal cavity has often been described as chronic peritonitis, oblitative or adhesive in character, depending on whether the entire peritoneal sac was obliterated or the fluid was absorbed in certain parts of the abdomen with sacculation of the remaining fluid. In nearly all cases perihepatitis is a prominent feature; a mass of adhesions surrounds and binds the liver under the diaphragm. This condition may be mistaken for cirrhosis, but when the shell of adhesions is incised to the surface of the liver the organ is found congested, but not cirrhotic unless a coincident cirrhosis is present. The spleen likewise shows perisplenitis; although it is usually rather large and congested, it does not regularly show chronic splenitis of the type seen in splenic anæmia. In some cases chronic vascular nephritis is a complication. The age of the patients affected varies from childhood to old age, but usually symptoms are initiated under thirty years, and the incidence is about evenly divided between males and females. Every surgeon of experience will remember having seen, in the course of his surgical experience, cases answering more or less to this description, usually with ascites, but occasionally without. The outstanding clinical picture is the development of ascites as a rule slow and painless and without œdema of the lower extremities. However, as Pick points out, if the cardiac complication is serious, there may be a little œdema of the lower extremities in the early stages, which disappears as the affection develops.

It is difficult clinically to distinguish ascites which is the result of multiple serositis from the ascites the result of cirrhosis of the liver, chronic splenitis of the splenic anæmia type, and tuberculous peritonitis. Tuberculous peritonitis is often associated with this condition, but while many observers have attempted to show that all cases are tuberculous, it has been proved that a very large percentage are not tuberculous.

Portal cirrhosis of the liver of the Laennec type is occasionally associated with multiple serositis. Hale White said that in most cases of portal cirrhosis of the liver with ascites, the ascites is a terminal symptom and the patient does not long survive the first tapping. This would indicate that many of the cases which have been diagnosed portal cirrhosis, in which frequent tapings have been made, are cases of peritoneal serositis, or cirrhosis of the liver associated with this form of chronic peritonitis. Equally interesting is the work of Fagge, who showed that in 10 per cent. of cases in which death resulted from cirrhosis of the liver tuberculosis of the peritoneum was an associated condition.

*Etiology.*—Many investigators believe that serositis is caused by some type of bacteria which affects the serous surfaces only. While bacteria, especially the bacilli of tuberculosis, have been detected, they are found so infrequently as to lead to the belief that they are accidental rather than causative. Rosenow's work on the specificity of bacteria is interesting in this connection. Certain writers believe that the disease is chemical in

nature and has its origin in the liver, unidentified toxins passing from the liver to the perihepatic peritoneum, and that the disease always begins as perihepatitis.

Twenty years ago, extensive investigation, especially by Clark in 1901 and by Dudgeon and Sargent in 1905, advanced our knowledge of the absorptive capacity of the peritoneal cavity. It is known that while fluids are absorbed readily by the peritoneum and enter the portal circulation, solid particles are taken up only by the central tendon of the diaphragm and pass into the mediastinal spaces. It is supposed that in this syndrome the causative agents pass from the mediastinal spaces to the lymphatics and the blood stream and are carried through the blood to the pericardium and the pleuræ, or, the reverse of this process is exemplified. A consideration of events leads to the belief that the causative agents act more directly; otherwise, why should this serositis be confined to the pericardium, the pleural sacs, and the peritoneum? If the causative agents were carried by the blood, the serous surfaces of the brain, the spinal cord, and the joints would be affected, but this does not occur in a proportion to be more than a coincidence.

From a surgical standpoint we are concerned with cases of long continued ascites, perhaps extending over years, for which repeated tapplings have been done. Cases have been reported in which the ascites has diminished gradually, eventuating in obliteration of the peritoneal cavity and absorption of the fluid. There appears to be little of a curative nature that can be done for the relief of the condition in the terminal stage. Perhaps some of the reported Talma-Morison operations have been performed in cases of multiple serositis in the belief that the condition was uncomplicated cirrhosis of the liver. We must remember that diagnosticians have not been on the lookout for these cases. As a matter of fact, the condition had been diagnosed clinically in less than 10 per cent. of the cases reported. Our knowledge has come largely from the necropsy room where the pathologist can view the whole picture, while the surgeon's exploration has been limited to the abdominal cavity. We may be taking a much gloomier view of the prognosis of this condition than is warranted. I remember a number of cases in which I operated for other conditions and found perihepatitis and chronic peritonitis without recognizing the nature of these serous manifestations; yet the patients recovered and remained well. There seems to be no inherent reason why this type of chronic peritonitis should always go to the post-mortem stage. I have no doubt that in operating for various conditions we remove causes of chronic peritonitis with the recovery of the patient without appreciating this phase of the situation. Now that our attention is focussed on the condition I believe we shall discover it very often and find that it is benign rather than malignant, and in some cases even a conservative or beneficent process.

Multiple serositis is a poor term for this syndrome, which probably does not represent a definite disease, but rather a manifestation of chronic serous

inflammation of three contiguous serous sacs, the pericardium, the pleuræ and the peritoneum, the result of many causes which we have heretofore recognized only in the terminal stage.

Recently a girl (Case A338275), suffering from the abdominal manifestations of multiple serositis besides a huge ovarian cyst, came under my care. The total weight of the tumor and ascitic fluid was 161 pounds; the girl weighed 107 pounds after the operation. The cyst, which was malignant, had perforated, and masses of carcinoma were freely exposed in the peritoneal cavity. The patient had been explored by excellent surgeons two years before who found the carcinoma, evacuated a large amount of fluid, and closed the abdomen without removing the cysts because of the malignancy. The peritoneum, therefore, had been exposed to fungating adenocarcinoma for two years, and probably much longer, yet there was no metastasis to the peritoneum, indicating that the sclerosed peritoneum, being without sufficient circulation to enable secondary growth to take place, afforded a poor soil for transplants. An interesting feature of the operation was that in spite of the great size of the tumor the patient was not cyanosed and had no especial difficulty in breathing or heart action. The very moderate evidence of the disease in the pericardium and the presence of fluid in the pleuræ, were thought to be the result of the pressure of the tumor. The fluid contents were emptied very slowly, since experience with large abdominal tumors had shown that sudden removal of the tension is liable to cause syncope. What was my surprise, after emptying all the fluid and removing the tumor completely, to find that the patient continued to breathe with ease, owing to the fact that the "iced liver" and the adherent spleen maintained fixation of the diaphragm. The adhesions in the pericardial sac and pleuræ had also helped to prevent upward pressure, so that when the tumor was removed the great cavity maintained much the shape of a half barrel without movement of the viscera. Excellent recovery followed; there was no return of fluid.

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## THYROID SURGERY AND THE DEMENTIA PRÆCOX SYNDROME\*

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AND

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DEMENTIA PRÆCOX, according to Kraepelin,<sup>1</sup> consists of a series of states, the common characteristic of which is a peculiar destruction of the internal connections of the psychic personality. The effects of this injury predominate in the emotional and volitional spheres of mental life. The assertion that this is a distinct disease has met with repeated and decided opposition.

It is the aim of this paper to record clinical observations which apparently support the suspicion that a very close relation exists between endocrine imbalance and dementia præcox.

Kraepelin, Cushing, Lewis and Davies, among others, have studied a practical aspect of mental disease and endocrine imbalance which is of interest to surgeons who have to do with thyroid diseases. This phase concerns the treatment of this and other forms of insanity by attacking directly the endocrine gland itself by surgical or non-surgical methods. Recently Lewis and Davies<sup>2</sup> have reported a considerable number of cases in which the psychic syndrome of dementia præcox was favorably influenced by thyroid extract therapy and hemi-thyroidectomy, chiefly the former. Most of their cases were of the sluggish, apathetic, introversion, hypoglandular type. These were treated with thyroid extract. Some were schizophrenic with paranoid symptoms, agitation, excitement, etc., and were classed as cases of hyperthyroidism. These authors suggest that their rather satisfactory attempts at treatment of dementia præcox through thyroid surgery and medication should be interpreted in terms of possibilities and not in terms of demonstrated facts or permanent achievements.

In the writers' cases it was the circumstance that dementia præcox was observed in four instances associated with only slight aberration in size and form of the thyroid gland, but not associated with the symptoms of frank thyrotoxicosis, which marked the cases as unusual and perhaps significant in some degree. Since all of the clinical symptoms of Graves' disease are largely of nervous origin, and all are emotional, many cases exhibiting rather definite forms of nervous and mental disease as mania, chorea, hysteria, etc., it is not at all surprising that the rather definite clinical syndrome of dementia præcox appears occasionally in connection with thyrotoxicosis. It is because of the clinical relief of dementia præcox, unassociated with Basedow's disease "in sensu strictiori," through apparent correction of endocrine imbalance by hemi-thyroidectomy, that a report is submitted.

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\* Read before the American Surgical Association, May 3, 1922.



The diagnosis of endocrine imbalance with the probable site of the injury in the thyroid was made in each instance by Dr. Lillian Crockett Lowder, of Indianapolis, in whose practice the cases occurred.

*CASE I.*—White female, age twenty-two. *Family History:* Mother and father are both living and in good health. There is no record of cancer, tuberculosis or mental and nervous disease. The family history as to goitre is noteworthy. On the paternal side the history is negative as to goitre. On the maternal side the grandmother had a simple goitre, two great-aunts had exophthalmic goitre, the mother has a simple goitre, one aunt has exophthalmic goitre and one brother has a simple goitre; likewise a sister who died at the age of thirteen had a distinctly enlarged thyroid gland.

*Personal History:* As a young girl the patient enjoyed good health with the exception of the usual childhood diseases. At the age of eighteen she began to feel that her strength was not the equal of that of her associates. She was graduated at high school and became a stenographer and for three years was employed in this work, after which she became indolent and quarrelsome, exhibiting introspection and introversion, in that she remained secluded in her room and avoided social contact wherever and whenever possible. Her habits became more and more solitary. She developed a violent hatred for her father, declaring that she was not his daughter and accusing him of attempts to poison her. She spent many hours wandering alone in the streets.

*Physical Findings:* The patient is a moderately well-built girl apparently about twenty-five years old. The eyes react well and there is a very slight degree of exophthalmos. Hyperopic astigmatism is present. The fundus is normal. There is a moderate enlargement of the right lobe of the thyroid and isthmus. Chest, abdomen and pelvis negative. There is a slight acceleration of the pulse, the rate being eighty to ninety a minute. The deep and superficial reflexes are exaggerated, especially the left patellar reflex. There is a slight tremor of the fingers. Blood and spinal Wassermann negative.

*Personal History in the Hospital:* The patient hid her toilet articles and house-slippers in the garbage can, occasionally wandering away from the institution to be found hidden or wandering aimlessly, clad in a thin nightdress, at zero temperature, in the streets. She described vocal hallucinations which she interpreted as the voices of God, Jesus and the Virgin Mary, which, as she said, had told her to put the articles in the garbage can. The voices quoted passages from the Bible and Science and Health.

*Diagnosis:* Dementia præcox, paranoid form.

*Treatment:* Hemi-thyroidectomy.

*Result:* After two weeks, the young woman returned to her normal mentality. She resumed her secretarial work, and for the entire period intervening since her operation, almost a year, she has been quite free of signs of mental aberration.

*CASE II.*—Female, age fifty-four, married. *Family History:* Negative as to goitre and insanity.

*Personal History:* That of a healthy woman until the age of fifty-three, at which time she became irritable and easily excited. She became jealous of her husband without cause and was convinced that a conspiracy existed between her husband and her nurse in which her destruction was planned. She developed violent hatred for her husband and made homicidal threats; she made several vicious attacks upon her husband's person. She heard threatening and insulting voices and was finally committed to an insane hospital.

*Physical Findings:* The eye ground is normal and there is no exophthalmos present; other ocular signs of Basedow's diseases are absent. The pulse-rate ranges

from ninety to one hundred. There is some precordial distress and slight fine tremor. There is no anasarca. The patient has lost about thirty pounds in weight. Examination of the thyroid gland reveals moderate enlargement of the right lobe and isthmus.

*Treatment:* Hemi-thyroidectomy was performed without apparent benefit so far as the psychosis was concerned until a period of five months had elapsed, after which the mental symptoms gradually disappeared and have not returned to the present time, which is four years after the thyroidectomy.

CASE III.—Female, age twenty-one. *Family History:* Negative as to cancer, lues and tuberculosis. Father was an alcoholic. An elder sister had a simple goitre.

*Personal History:* Patient has had excellent health until present illness, excelling in basket-ball and tennis and holding the world's pole-vaulting record for women. Her class work at Indiana University was excellent. After graduation she procured a position as instructress in athletics. After a few months she began to shirk her work and became quarrelsome and neglectful of all her duties. She developed a marked hatred toward her relatives and accused them of conspiring against her welfare. There were other distinct phobias. She refused to go out on the street for fear of evil befalling her and demanded removal from her home because of her fear and hatred of a kind and indulgent mother.

*Physical Findings:* Very slight exophthalmos and enlargement of the right lobe of the thyroid. Pulse somewhat accelerated. There was a coarse tremor of slight degree observed in the fingers. After thyroidectomy the psychosis disappeared, and at this time, almost six years after the operation, the patient is in perfect health and is an instructress in the high school of Palm Beach, Florida.

CASE IV.—Female, age twenty-seven. *Family History:* Negative as to goitre and insanity.

*Personal History:* Patient, who had been an industrious and amiable young woman, was dismissed as a teacher because of her vulgar and quarrelsome attitude toward her pupils. This action was taken by the school board on complaint of parents. She was extremely agitated and described auditory hallucinations and delusions of persecution. She developed hatred for her husband, resulting in divorce, because of her angry tirades and threats of violence. She lived in a tormented state of distrust of her friends and relatives.

*Physical Findings:* The eye ground was normal and there were no ocular signs of Basedow's disease and no tremor except when patient was especially agitated and combative. Unilateral enlargement of the thyroid gland was present.

*Treatment:* Hemi-thyroidectomy.

*Result:* Relief of psychosis. The patient, though somewhat nervous, is able to carry on her work as teacher.

There is a large amount of evidence to show that there is a functional correlation between the ductless glands and the nervous system, but the exact nature and extent of this correlation have been explained on such varying and contradictory hypotheses by different investigators that the resultant deductions are rather unsatisfactory. Thus, Berkley,<sup>3</sup> in 1908, reported ten cases of thyroidectomy for catatonic dementia præcox with brilliant results. The after-course of the cases coincided with his belief that the condition was primarily one of hyperthyroidism. In those patients whose thyroids subsequently enlarged, there was an immediate return of catatonia, mutism, etc., which disturbances in turn disappeared as the gland spontaneously diminished

in size. Since thyroid secretion is an accelerator principle, activating the nervous system to a hyperexcitability, it is rather surprising to find cases of catatonia, a condition associated with apathy and negativism, relieved by thyroidectomy. The report of Kanavel and Pollock,<sup>4</sup> who obtained negative results from thyroidectomy in twelve cases of catatonic dementia præcox, falls more in line with our present physiologic conceptions.

Working along somewhat different lines but upon the same problem, Uyematsu<sup>5</sup> found the blood clotting time of catatonic dementia præcox cases definitely shortened. Hypersecretion of the thyroid gland is accompanied by a prolonged coagulation period of the blood, while hyposecretion is usually associated with shortening of the same. Here is an interesting similarity between catatonia and hypothyroidism. The hæmatologic study also points to another remarkable resemblance between these two conditions in that the platelet counts in myxœdema, cretinism and catatonic dementia præcox are exceedingly increased. In the matter of sugar tolerance Lewis and Davies<sup>6</sup> have also pointed out the similarity, since in both catatonic dementia præcox and hyperthyroidism there is a markedly increased tolerance. The one case in their report showing a delayed absorption phenomenon was of paranoid dementia præcox manifesting definite signs of hyperthyroidism.

While it would thus seem that the catatonic form of dementia præcox has been rather definitely identified with a deficient secretion of the thyroid gland, we have been unable to find any reports to show the nature of the relationship, if any exist, between the agitated and paranoid types of dementia præcox and the thyroid gland. It was an inquiry into this relationship that the following investigation was made at the Central Insane Hospital at Indianapolis. Consecutive cases of dementia præcox, irrespective of type, were examined for signs of endocrine imbalance. Special attention was paid to thyroid hypertrophy. Since anatomic variation might enter largely into such an investigation, care was exercised to record thyroids as enlarged, only when they were visibly hypertrophied.

Of twenty-seven male patients, eleven, or forty per cent., presented some degree of thyroid hypertrophy. Of this number two had large goitres, six showed a conspicuous enlargement, while the remaining three manifested a moderate hypertrophy of one or both lobes. Twelve of the men presented definite signs of vasomotor disturbances, especially in the hands, which in eight cases, or twenty-nine per cent., were characteristically purple and cold. Six cases, all over twenty-one years, had little or no beard, the hair elsewhere on the body, however, appearing normal. Three cases showed underdeveloped genitals. One case presented, in addition to a markedly enlarged thyroid and cold hands, an outstanding overgrowth of the long bones. It is interesting to note that of five cases of catatonic dementia præcox among the group, not one showed any thyroid enlargement.

Of seventy-four female patients, forty-eight, or sixty-four per cent., presented some degree of thyroid hypertrophy. The number of actual goitres

in the group was surprising, amounting to eighteen in number, or twenty-four per cent. Of these eighteen, nine exhibited goitres that were apparently cystic, four had median lobe enlargement and two had discharging sinuses from the goitre, evidently due to a purulent thyroiditis. Menstrual disorders were common, over one-half of the women complaining of irregularity and ten who were under thirty-five did not menstruate. As in the male patients, vasomotor disorders were conspicuous, eighteen of the women, or twenty-three per cent., presenting the cold, purplish hands noted in the men. Four women had an abnormal growth of hair on the face.

In both the male and female patients, the cardinal symptoms of thyrotoxicosis, with the exception of goitre, were notably absent.

It has been observed that a certain percentage of cases of dementia præcox, more particularly those of the catatonic and hebephrenic types, suffer from marked constitutional disorders, more prominently, insomnia, cyanosis, emaciation, circulatory and vasomotor disturbances and disturbed cardiac action. These symptoms, together with the early age incidence of the disease, have naturally led investigators to correlate it with the concomitant ovarian, testicular and thyroid changes. In lieu of a more satisfactory explanation of these physical findings, they have usually been regarded as subsidiary and resultant upon the primary mental changes. These facts are noted by Jelliffe,<sup>7</sup> who is of the opinion that, despite them, dementia præcox must as yet be looked upon as simply an "introversion psychosis," a term which describes the most characteristic quality of the disease but goes no further.

Rather constant and definite regressive changes in the testes and ovaries of dementia præcox cases were found by Sir Frederick Mott.<sup>8</sup> Of course he did not conclude that dementia præcox is caused by such changes, but remarks that this close association, to be understood, will require much further investigation. Hemmeter and Friedman, on the other hand, have with apparent justice claimed that all ductless gland disturbances may manifest themselves clinically without macro- or microscopic alterations of these structures.

If it is true that an abnormal condition of the ductless glands, resulting in an endocrine failure or disorder of the endocrine equilibrium, has a causative relation to dementia præcox, one might expect to discover a structural defect or change in the corresponding glands at autopsy. Kojima,<sup>9</sup> who examined the ductless glands of two cases of dementia præcox post-mortem, comes to the conclusions that in males there is a tendency to hypofunction and in females to hyperfunction of the thyroid. Microscopically, he found that the thyroid vesicles vary in size and are distended with colloid, that there is an excess of intravesicular connective tissue and a flattening of the epithelial cells. Ramadier and Marchand<sup>9</sup> found in a female case, age seventeen, a gland that weighed five grams, in which there was a marked sclerosis. In four other cases they found more or less sclerotic changes, an atrophy of the vesicles and a great variation in the quantity of colloid; in one case no changes

were observed. On the other hand, Parhon and others found no sclerotic changes, but a marked distention of colloid in the vesicles. It would thus appear that while there are undoubtedly structural changes in the thyroids of some dementia præcox cases, these changes are not definite or constant, in some instances there being a hyperfunction, in others a sclerosis associated with hypofunction.

Berkley thought that by resection of a lobe of the thyroid gland he could increase the blood supply to the parathyroids. He recommended the administration of lecithin at the same time. This procedure has been repeated several times by Judin, in two cases, by van der Scheer in seven cases, almost always without results. Van der Scheer saw improvement in two cases of which the one ran its course with Basedow's phenomena, the other exhibiting struma. Pinheiro and Reidel report somewhat more favorable results. Pinheiro observed improvement after administration of parathyroidin. The pulse and disorders of metabolism were found by him to be influenced favorably. Many years ago Kraepelin endeavored for a long time to influence dementia præcox by the use of extracts of almost every possible organ, including the thyroid gland, the testes and the ovaries, but unfortunately without any effect.

It seems reasonable at this time to regard thyroid therapy as a therapeutic agent in dementia præcox with doubting expectancy as its maximum appraisal, notwithstanding that its application in some cases has been followed by improvement or recovery.

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## CONGENITAL HYPERTROPHIC STENOSIS OF THE PYLORUS IN THE ADULT \*

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ONE of the greatest diagnostic feats of medicine was the recognition in 1788, by Beardsley, an American, of the condition known as congenital hypertrophic stenosis. Following the description by Beardsley, no definite exposition of this condition occurred until 1879. In that year Heinrich Landerer, of the University of Freiburg, gave the first real description of the disease. He not only discussed the congenital form, which is by far the most common, but he also described ten cases of narrowing of the pyloric outlet in adults (43-63 years of age). In these cases there were no pathological changes other than a simple narrowing of the pyloric orifice. The stomach was markedly dilated but no thickening of the pylorus was noted in any case.

In 1888 Hirshprung wrote his classical paper on "Congenital Hypertrophic Stenosis of the Pylorus." This paper established the disease as a definite clinical and pathological entity. John Thomson published his paper nine years later (1897). Following the above papers, many contributions have been made which have confirmed these early observations. A rather recent contribution is the observation that hypertrophy of the pylorus is frequently associated with enlargement of the thymus gland. The exact relationship between these two phenomena is not clear but it affords much ground for speculation.

Four theories as to the causation of this condition have been advanced. It is probable that a combination of these theories approximates the truth. The most common theory is that it is a developmental overgrowth. A second hypothesis is that we are dealing with a primary spasm resulting from local irritation followed by muscular hypertrophy. Third—it has been suggested that there is a congenital narrowing of the pyloric lumen followed by hypertrophy. Lastly, some advocate the idea that there exists a functional disorder of the nerves to the stomach and duodenum, leading to an ill coördination and, therefore, an antagonistic action of their muscular arrangement. Such a functional nervous derangement occurring per se seems most unusual. Like most other functional disturbances, investigation will probably show a direct underlying cause.

Such are the interpretations of the etiology of congenital hypertrophic stenosis in the infant. In this paper our discussion concerns congenital hypertrophic stenosis in the adult. True hypertrophic stenosis in the adult must, perforce, have the same etiological basis as the infantile form. We

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are simply dealing with a congenital condition which persists into adult life. Such causes as chronic gastric or duodenal ulcer with cicatrization and secondary stenosis must of course be ruled out. Likewise, gastric carcinoma, adenomata, syphilis, tuberculosis, typhoid fever and hypertrophic gastritis, while being of great importance with regard to differential diagnosis and pathology, are obviously not to be confused in the discussion of its etiology. The etiology of the infantile and adult forms are identical because we are dealing with the same condition. The adult form is extremely rare, largely because, if unrecognized in infancy, the child dies before attaining maturity.

There are several conditions in the adult which may closely resemble congenital hypertrophic stenosis. The most common ones are carcinoma of the pylorus, peptic ulcer with stenosis of the pylorus, sarcoma and syphilis. Tuberculosis, though rare, must also be considered. Actinomycosis and typhoid ulceration are extremely rare and hardly to be confused.

The differential diagnosis of these conditions is fully discussed in various text-books and will not be entered into here.

*Previous Case Reports.*—Stenosis of the pylorus in adults has been previously described in medical literature. Most of the reported cases, however, are those forms of stenosis which are secondary in nature. I refer mainly to those cases following gastric carcinoma involving the pylorus, gastric or duodenal ulcer with cicatrization, syphilis of the stomach and other diseases which leave an obstructive lesion at the pylorus. These cases are essentially of different origin from true uncomplicated pyloric stenosis.

Cautley and Dent, in 1902, mention three cases of pyloric stenosis in individuals aged six, eleven and twenty-two years respectively. They believed all three of these cases to be of congenital origin. The cases here referred to were cases of simple stenosis of the pylorus without hypertrophy. The congenital origin of a simple stenosis of the pylorus without the muscular hypertrophy would be exceedingly difficult to prove.

Maylard, of Glasgow, in 1904 suggests, in a paper entitled "Congenital Narrowness of the Pyloric Orifice," that many cases of chronic gastric derangement are due to this cause. These observations were made from operative procedures in which the stomachs were examined. He, also, recorded a case of hypertrophic stenosis in a man, aged thirty-one years, which he believed to be congenital in origin.

Mayo Robson and Moynihan in 1904 expressed the belief that it is likely that such conditions may exist, but that the evidence offered was not sufficient to establish its identity.

Russell describes three cases of simple stenosis in adults that he thought were of congenital origin. The evidence furnished leaves considerable room for doubt. One case of hypertrophic stenosis reported by the same author was undoubtedly carcinoma, as malignancy was definitely present at the fundus.

These are the only references I have been able to find dealing with the subject at hand. The case described by Maylard of Glasgow was probably the first example on record, but, unfortunately, it was impossible to establish its origin. The history obtainable was very meagre and nothing was known of the infantile record of the case.

## JOHN CHADWICK OLIVER

### REPORT OF CASE

Mr. J. G., lithographer, aged fifty-one, was first seen on December 27, 1919. He was referred by Dr. R. Gaston, for surgical treatment. His chief complaints were gastric distress (dyspepsia), excessive vomiting, sour eructations and progressive loss of weight. The duration of his present illness was indefinite (about one year), but he stated he had had stomach trouble all his life. He would have periods of relief for several months at a time, followed always by a return of his trouble. Between the ages of eighteen and thirty-five he was relatively free from attacks and during this time he steadily increased in weight until he weighed about 170 pounds. Since that time (sixteen years ago), he has lost weight and in the last year has declined rapidly, until his weight is 103 pounds. His mother states that when he was an infant "she had a terrible time raising him." He was under-nourished, vomited a great deal, and was markedly under weight. As a young child he suffered periodically from "biliousness" and vomiting. He never suffered from any localized pain, merely a sense of fullness, followed by vomiting of large amounts of partially digested food and mucus. No definite history of his condition could be obtained prior to the time he was seen by Doctor Gaston, other than the above description.

For eight years prior to operation was constantly under medical care, without receiving any benefit. Previous to that time he was not bothered so much, but on looking back he thinks he may have had milder manifestations, but as they had always been present did not realize that there was anything wrong with him.

At the time we first saw him, he appeared cachectic and his features were peculiarly similar to patients suffering from advanced carcinoma. His complexion was of a sallow, pasty nature. The eyeballs were quite prominent, the malar eminences protruded and the cheeks were sunken and drawn; his whole appearance was one that bespoke despair. The neck was wasted and the sternomastoid muscles were sharply outlined. The thyroid gland was not enlarged. There were no abnormal pulsations in the neck, but the veins of the neck and forehead were quite distended. The chest was symmetrical and the expansion equal on the two sides. The ribs and the intercostal spaces were easily seen. No pathological findings were noted in the heart and lungs.

The examination of the abdomen was of great interest. The upper abdomen was distended, the distention extended down below the umbilicus about one and a half inches. The abdomen was soft and there were no signs of any inflammatory disturbance. Tenderness and pain were absent, except for a feeling of discomfort on pressure in the epigastrium. The lower abdomen and pelvis were apparently normal. No free fluid could be detected in the abdomen. The stomach was very greatly dilated, this being the cause of the distention above noted. The outline of the stomach could be easily mapped out. Marked peristaltic waves were visible traveling periodically from left to right. These waves were easily induced by tapping the abdomen with the finger. They were periodic in nature, being synchronous, of course, with the muscular contractions of the stomach. A small, hard mass could be felt on palpation at the pylorus, just to the right of the mid-line, slightly below the umbilicus. This mass appeared to be about the size of an olive.

Examination of the extremities revealed no abnormal findings. There was no adenopathy present; the inguinal, cervical and axillary glands exhibited no enlargement on palpation. The X-ray examination revealed an obstruction at the pylorus, which was thought by the X-ray man, Dr. S. Lange, to be due either to an ulcer or to carcinoma. His report is as follows: "The X-ray pictures reveal a marked obstruction at the pyloric end of the stomach. The findings are suggestive either of an ulcer, with stenosis of the pylorus, or carcinoma. An exact statement cannot be made."



## HYPERTROPHIC STENOSIS OF THE PYLORUS

Gastric lavage revealed several interesting and instructive findings. It was necessary to wash out the stomach numerous times to afford relief from the excessive vomiting present. He experienced immediate relief after each lavage. The character of the wash was very instructive. Six or eight quarts of water had to be used each time before the fluid was returned clear. There was a great deal of undigested food present, particles of food that were eaten eight days previously being found in the return fluid. After washing the stomach completely of its contents and emptying it, it was frequently necessary to introduce three quarts of water before any siphonage was established. This of course, suggested the great dilatation present, large quantities being necessary to induce antiperistalsis. The stomach contents were not colored with bile, the color being light yellow and turbid because of the admixture of food. The vomitus had a sour, rancid odor due largely to the fermentation present in the stomach. On analysis, the stomach contents showed a hypo-acidity, a reduction in both the free HCl and combined HCl being present (free HCl 1005, combined 1020). Lactic acid was also present, as well as numerous bacteria. No Boaz Oppler bacilli were found. Bile was not present. Several analyses were made and they all revealed a marked hypo-acidity.

The findings above recorded suggested either an ulcer of the pylorus with secondary cicatrization and obstruction, or carcinoma of the pylorus, with the probabilities being in favor of the latter diagnosis. A laparotomy was advised and it was suggested that a posterior gastro-enterostomy be performed. The patient willingly gave his consent and the operation was performed on December 29, 1919.

*Operation.* The patient's stomach was thoroughly emptied the night before, and no food given either the evening before or the morning of operation. He was given the usual preparatory treatment.

Digital examination revealed an annular thickening at the pylorus extending about one and a half to two inches. The thickening was noted to be present for about one-half inch beyond the pyloric ring. It was an annular hypertrophy about the consistency of cartilage, and smooth throughout. The mesenteric glands in the neighborhood of the stomach and duodenum were not enlarged. No evidence of an ulcer with cicatrization was found. There was no scar tissue present. The absence of enlarged glands, the cartilaginous, smooth, even character of the thickening to the touch and the smooth, glistening appearance on examination, were quite different from the findings in carcinoma. The hypertrophy was distinctly confined to the muscular and submucous layers and was uniform throughout as demonstrated later by incision. The stomach was enormously dilated, and looked like a large collapsed sac. The pyloric orifice was tightly contracted. It was decided that a Rammstedt operation be done because of the marked similarity between this case and the condition found in the congenital stenosis of infants. The pylorus was correspondingly slit longitudinally through the submucous layer to the mucosa, for about one and a half inches. This at once relieved the stenosis. The finger could now be pushed through the pyloric opening with ease. After relieving the stenosis as described above, the abdomen was closed in the usual manner. A diagnosis of congenital hypertrophic stenosis of the pylorus in the adult was made at operation.

Following the operation the patient had an almost uncomplicated convalescence. He was allowed to take fluids the day after operation. He retained all the food taken and suffered no nausea or vomiting. After a few days a light diet was allowed and it was taken with relish. He was encouraged to drink plenty of water. His appetite became ravenous within a week's time. For the first time in years he was having normal bowel movements each morning. The stools were of good consistency and well formed. The patient was put on a general diet

after the first week. On January 20, 1920, he was discharged. He had gained seven pounds and felt greatly benefited. The patient was placed under Doctor Gaston's supervision after leaving the hospital.

In September, 1920, nine months after operation, he was seen at the office. He has gained 30 pounds in weight, now weighing 130 pounds. He states that he eats freely of various kinds of food and that his appetite is very good. His stomach is still somewhat dilated but much smaller than before operation. His general health is excellent and he presents an amazing difference in appearance from the man of nine months ago.

*Treatment.*—The treatment in the above case differs from the previous cases reported in the employment of the Rammstedt operation. Maylard and Russell both performed posterior gastro-enterostomies in their cases. It was thought that if the Rammstedt operation produced such excellent results in infants, with consequent less shock and trauma, in adults too it should be preferable. The use of the Rammstedt operation, likewise, obviates the necessity of diverting food from its normal channel and, hence, produces none of the digestive defects that often follow gastro-enterostomy. The simplest method of relieving the obstruction present, should be the operation of choice. In this case, simple division of the muscular and submucous layers of the pylorus produced eminently satisfactory results.

*September 1, 1921.* Patient was seen on above date and his condition remains substantially the same as reported one year ago. There is still a slight dilatation of the stomach present but he is practically free from symptoms and looks exceedingly well. His weight is at present 140 pounds, his color good and appetite excellent. His general condition is decidedly satisfactory. *January 16, 1922.* The patient has remained in good condition and is entirely free from symptoms of obstruction. His weight remains at 140 pounds and his general appearance is that of a man in good health.

## SURGICAL TREATMENT OF SYPHILIS OF THE STOMACH\*

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It is only within very recent years that syphilis of the stomach has been taken out of the realm of rare medical curiosities and has been recognized as a condition of sufficient frequency to warrant serious attention. Curtis<sup>1</sup> as recently as 1909 made the significant statement that in only two of the sixteen cases then in the literature had complications arisen which were amenable to treatment. Perforation of ulcers had occurred in both of these cases, one of which was reported by Fraenkel<sup>2</sup> and the other by Flexner.<sup>3</sup> The application of the Wassermann reaction and the development of the X-ray examination of the stomach have led not only to the recognition of the greater frequency of these cases, but also to the diagnosis of many of them even without operation. The literature in the last few years has therefore shown an increasing number of articles devoted to this subject. It is worthy of comment, however, that certainly in the majority of instances the diagnosis has been made by more or less indirect methods, such as the association of suspicious lesions with a positive Wassermann reaction, marked deformities of the stomach as revealed by the X-ray but without the corresponding cachexia and anæmia of carcinoma, and other indirect evidence. So far as I have been able to discover from the literature, in not a single case of gastric syphilis have the spirochætes been found. Symmers,<sup>4</sup> in 1916, in reporting a case of syphilitic ulcer of the stomach in which death occurred from hæmatemesis, stated that Pappenheimer and Woodruff were able to find only twelve other acceptable cases of syphilitic gastric ulcer in the literature. In the case of Symmers the diagnosis was made at autopsy by the finding of multiple ulcers of the stomach which microscopically showed miliary gummas, endarteritis obliterans, and circumvascular plasma and round-cell infiltration.

The diagnosis of gastric syphilis will not be discussed extensively in this article. Excellent accounts of the diagnosis have been given by Mills<sup>5</sup> and by Eusterman.<sup>6</sup> Instead emphasis will be placed here on the treatment of the surgical complications, of which the most commonly recognized are pyloric stenosis and hour-glass formation. Apparently, however, any of the sequelæ of ordinary peptic ulcer may occur also with the syphilitic ulcer. Perforation has already been noted above in the cases of Fraenkel and Flexner. Severe hemorrhage has also been known to occur. Except for the acute complications, such as perforation or hemorrhage, the conditions which have called for surgical intervention have usually represented the final stage of healing

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\* Read before the American Surgical Association, May 2, 1922.

and have therefore been concerned with the results of scar formation. It is not surprising then that the most common indications for operation would be stenosis of the pylorus, hour-glass formation, or other conditions due to perigastric adhesions, etc. The process is of course analogous to the syphilitic strictures of the rectum. It is also not surprising that the search for spirochaetes has so far been futile.

A search of the literature shows that an operation has been performed for gastric syphilis on thirty-two patients. In many of these cases the diagnosis

has been merely clinical and in others it has been supplemented by a microscopical examination of excised tissue. Of the reported cases, gastro-enterostomy has been performed in seventeen instances and resection of the pylorus in four instances. Eusterman,<sup>7</sup> in reporting cases from the Mayo Clinic, states that ten operations were performed but he does not state the kind



FIG. 1.—Case III. Resected pyloric portion of stomach split open on side of lesser curvature to show tumor obstructing lumen. The hypertrophied muscle is clearly shown.

of operation; it is evident from his article, however, that some of them were pyloric resections. In the accompanying table are shown the results reported by various authors after either gastro-enterostomy or resection of the pylorus. The results are difficult to interpret accurately because in many cases the data are unsatisfactory. In general, however, they show marked improvement. There have been only two deaths, one from nephritis and one on the third post-operative day in a case which presented numerous small ulcers in the duodenum. With the exception of the series of eight cases of Castex in which gastro-enterostomy was done with no permanent relief of symptoms, almost equally good results have occurred regardless of whether a resection or merely a gastro-enterostomy has been done. It should be stated that Castex performed gastro-enterostomy not only in cases in which evidence of pyloric stenosis existed, but also in some in which merely an ulcer of the stomach or duodenum was present which had been diagnosed clinically as syphilis. On the basis of these results Castex suggests that gastric or duo-

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denal ulcers whose symptoms do not disappear after gastro-enterostomy should be regarded as syphilitic and placed on specific treatment. It is doubtful, however, how many of such cases should be regarded as definitely syphilitic. It would seem that in cases of outspoken pyloric stenosis, no matter from what cause, surgical intervention would certainly give relief. On the other hand, many cases of syphilitic pyloric stenosis, even of high grade, have been entirely relieved of symptoms after a course of anti-syphilitic treatment. See in this connection articles by Eusterman, Beclere and Bensaude, Fowler, Hausmann, etc.

The difficulty of accurate diagnosis makes any analysis of results somewhat unsatisfactory, since cases which are regarded by some as syphilitic would doubtless be considered as questionably syphilitic by others. Again, also the



FIG. 2.—Case III. Longitudinal section of pyloric portion and tumor.

pathology is not accurately described, so that it is uncertain whether the condition for which operation was undertaken was an actual pyloric stenosis, active ulcer of the stomach, or some other condition. Of the three cases of apparently definite syphilis of the stomach upon which I have operated, two presented a type of lesion which has received but little comment and for the treatment of which there have been reported so few observations that apparently no good precedent has been established. These are the cases in which there is moderate thickening of the whole stomach which is reduced in size, an absence of pyloric stenosis and an absence of any gross deformity such as hour-glass formation or extensive perigastric adhesions. The symptoms may be very distressing and consist of vomiting, pain, loss of weight, etc. It has been chiefly from a desire to arouse discussion and to profit by the experience of others that I report these cases.

CASE I.—White woman, aged thirty-one. Admitted to Barnes Hospital, October, 1920. Began to have vomiting eight years ago. Vomited immediately after eating, without nausea. In September, 1919, had large hæmatemesis of brown clotted blood. Again in November of same year had large hæmatemesis and was thought to be dead. Has lost 80 pounds since origin of trouble. Has had three miscarriages. Examination showed secondary anæmia, Wassermann four plus, perforated nasal septum, no free HCl in stomach. X-ray by Doctor Mills showed moderate delay in emptying of stomach, with deformity of pylorus, with possibly syphilitic ulcer (serpiginous) of pylorus. Previous antisyphilitic treatment for four months with both salvarsan and mercury resulted in improvement



FIG. 3.—Case III. Section through tumor showing structure resembling a miliary gumma at point marked A.

of symptoms but without complete recovery. On October 20, 1920, a laparotomy was performed. Stomach found smaller than normal. Pylorus readily admitted finger. No enlarged glands. No perigastric adhesions. Slight thickening of whole stomach but no localized induration and no definite evidence of ulcer. No evidence of carcinoma. Duodenum normal in first portion. Liver normal. Gall-bladder slightly thickened but no stones or adhesions. Because of absence of definite evidence of organic pyloric stenosis or of active ulcer no operative procedure was undertaken on the stomach except to remove a small piece of the anterior wall for microscopic examination. A microscopic examination of the removed piece showed the mucosa slightly thinner than normal. The whole of its outer border was densely infiltrated with small medium-sized mononuclear cells. Typical polyblasts, few plasma cells and a few polymorphonuclear cells were in this infiltration. A similar infiltration was seen focally in the lower portion of the mucosa. There were a few mononuclears in the wall of the endothelial-lined spaces in the serosa. A diagnosis was made of chronic atrophic gastritis, probably syphilitic.

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The patient was again placed on antisyphilitic treatment. About six months after leaving the hospital she died, following an abortion. Death was presumably due to infection.

CASE II.—Colored man, aged twenty-four, Pullman porter. Entered Barnes Hospital, May 16, 1921. Onset October, 1917, with choking sensations in throat and palpitation with precordial pain. Vomited food eaten on same day. Course progressively worse so that at times fasting was necessary for several days. To relieve feeling of distention, induced vomiting brought up bloody material with food. Pain in epigastrium sometimes but not always relieved by food. Constipated. Salts every day. Lost 17 pounds in last 6 months. Examination showed mass in epigastrium. Free HCl 26; total acid 40. Wassermann negative

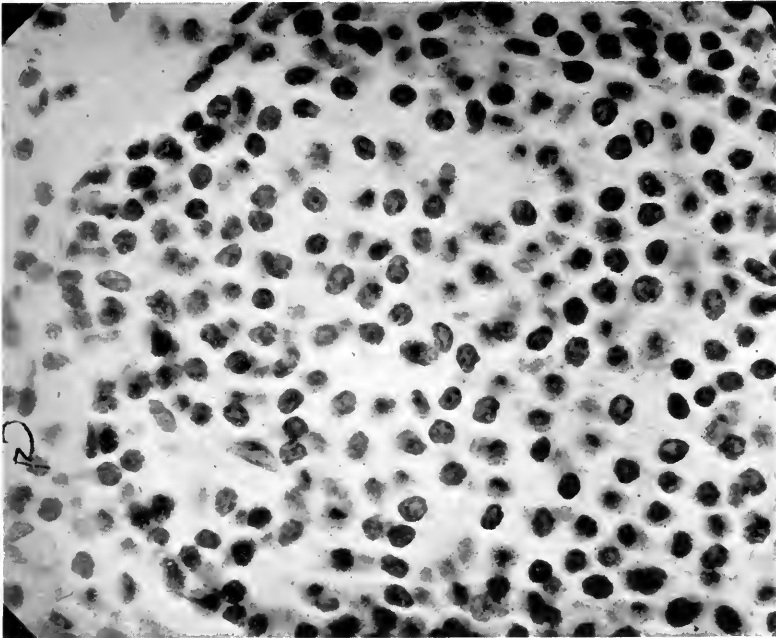


FIG. 4.—Same as Fig. 3, showing character of cells in the small gumma.

in both blood and spinal fluid. Hæmoglobin 80 per cent., leucocytes 7200, erythrocytes 5,160,000. X-ray (Doctor Larimore and Doctor Mills) showed superficial lesions involving distal portion of pars pylorica of type suggesting luetic ulceration. Stomach empty at five and one-half hours. On May 23rd laparotomy. Stomach found somewhat smaller than normal. Moderate thickening of pylorus, but nothing definitely indicative of ulcer. No enlarged glands. Liver normal. Posterior gastro-enterostomy with no loop done, and appendectomy. The stoma was about two inches in diameter. Piece of stomach wall next to gastro-enterostomy opening showed infiltration of all coats of stomach with round cells which were not, however, limited to blood-vessels. Uneventful recovery. X-ray examination (Doctor Mills and Doctor Larimore) on September 18, 1921 (4 months later) showed good function of gastro-enterostomy but no marked change in appearance of lesion. Patient's condition much improved with gain of about 15 pounds in weight but there was still some epigastric discomfort and fullness. In April, 1922 (about one year later), at another examination it was found that

about the same condition persisted. Gastro-enterostomy opening still patent but patient still complaining of discomfort almost immediately after eating. The beneficial result of the operation, although definite, has not been striking. Possibly, in view of the negative Wassermann reaction, this case should not be regarded as positively one of syphilis, but yet the other findings seemed to accord with that diagnosis.

CASE III.—Definite pyloric obstruction. Colored woman, aged forty. Entered Barnes Hospital, April 29, 1921. Symptoms of epigastric discomfort for about 16 years. For last four months there has been vomiting after every meal. Constant throbbing pain in left upper quadrant. Loss of weight of 35 pounds. Sometimes

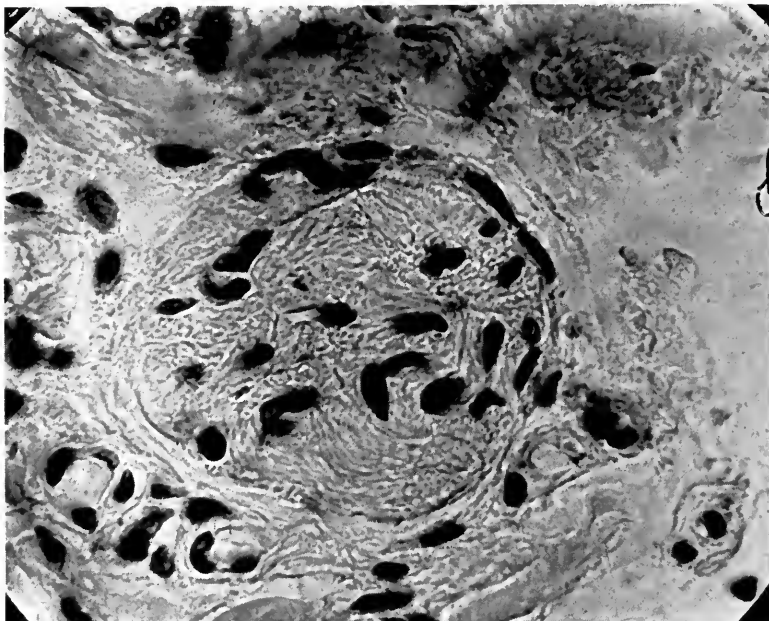


FIG. 5.—Same specimen as Fig. 3, but showing obliterating endarteritis.

vomits food eaten on previous day. Three miscarriages. Wassermann four plus. Free HCl varied from 3 to 6. Visible peristalsis in stomach. Hæmoglobin, 70 per cent., reds, 3,420,000; leucocytes, 11,000. X-ray (Doctor Mills and Doctor Larimore), lesion of pars pylorica, probably luetic. Small residue in stomach at 24 hours. On May 10, 1921, laparotomy was performed. Stomach about normal size despite pyloric obstruction. In pyloric region a definite tumor could be felt about the size of a hickory nut. This was slightly movable within the stomach and felt somewhat like an adenoma. It was definitely limited to the interior of the stomach, and there was no change in the gross appearance of the outer layers of the stomach suggestive of a carcinoma. There were no enlarged glands. The stomach was opened to inspect the tumor, which was found nearly obstructing the pyloric orifice and arising from the greater curvature side of the stomach. It was covered with mucosa. A resection of the pylorus was done followed by a gastro-jejunosotomy by the Polya-Balfour method. Uneventful recovery. X-ray examination (Doctor Mills) two weeks later showed "admirable conditions after gastric resection and gastro-jejunosotomy." Antisyphilitic treatment was also instituted.



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A report from the patient was received on April 12, 1922 (11 months after the operation), which stated that she was entirely relieved of her symptoms, that she had gained markedly in weight and that she was eating a general diet.

Microscopic examination of the tumor showed numerous small gumma-like collections of round cells beneath the mucosa. There was very marked perivascular infiltration with thickening of the intima of some of the arteries. There were occasional small areas of necrosis. These collections of cells were seen in the muscular layers as well as in the submucosa. Doctor Opie, who examined several of the sections, expressed the opinion that they presented very striking evidence of syphilis. Levaditi stains, however, failed to reveal spirochaetes.

TABLE I

Results of Surgical Treatment in Gastric Syphilis.

Author	Gastro-enterostomy	Resection	Result
Mills <sup>10</sup> .....	One case	.....	Marked improvement
Downes and Le Wald <sup>11</sup> .....	Five cases	.....	4 well, 1 died of nephritis
Hubbard <sup>12</sup> .....	One case	.....	Well
McNeil <sup>13</sup> .....	.....	One case	Good
Mühlmann <sup>14</sup> .....	One case	.....	Excellent
Culler <sup>15</sup> .....	.....	One case	Fair
Douglas <sup>16</sup> .....	.....	One case	Excellent
Eusterman <sup>6</sup> .....	10 operations but types not specified	.....	3 "cured", 5 much improved 2 not heard from
Dasso <sup>17</sup> .....	One case	.....	Well
Beck <sup>18</sup> .....	.....	One case	Well
Castex <sup>19</sup> .....	Eight cases	.....	Symptoms returned in all cases.
Sparmann <sup>20</sup> .....	One case	.....	Death on third day. Numerous small ulcers in duodenum.
Graham .....	One case	One case	Resection case well. Gastro-enterostomy case improved.

Another type of lesion which is possibly syphilitic is the gastric or duodenal ulcer associated with so-called gastric crises in tabes dorsalis. A recent case of moderately advanced tabes came to the hospital with attacks of vomiting and marked epigastric pain. The patient was supposed to be suffering from a gastric crisis. An X-ray examination by Doctor Mills disclosed a duodenal ulcer with a residue in the stomach after twenty-four hours. A posterior gastro-enterostomy was done, followed by complete relief of the gastric symptoms, and a gain of thirty-five pounds in weight. Vigorous anti-syphilitic treatment was instituted after the operation. There was nothing either in the findings at the X-ray examination or at operation to suggest particularly a syphilitic origin of the ulcer, and it is possible that there is no good reason to assume anything more than a coincidental relationship.

In conclusion, it should be stated that surgical complications of gastric syphilis occur with probably greater frequency than is commonly recognized. These consist usually of deformities produced by scar tissue formation in the healing of the syphilitic process. They are commonly seen, therefore, as stenoses at or near the pylorus, but sometimes as hour-glass contractures or perigastric adhesions. In another group in which there is impaired motility

without organic stenosis of the pyloric orifice but with rather generalized sclerosis of the whole stomach, it is doubtful how much good, if any, can be accomplished by surgical measures. In a study of thirty-four cases (including thirty-two from the literature and two from the author's series) resection of the pylorus gave uniformly good results in cases of stenosis of that orifice, while gastro-enterostomy was frequently followed by only slight or temporary improvement. It would seem, therefore, that pylorectomy is more likely to be followed by complete relief of symptoms than is simple gastro-enterostomy, although a study of more cases may show that the latter operation is sufficient in cases of actual stenosis of the pylorus. There will remain certain cases without organic obstruction in which surgical measures will probably not be indicated.

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# LATE RESULTS OF GASTRO-ENTEROSTOMY FOR GASTRIC AND DUODENAL ULCERS, INCLUDING ACUTE PERFORATED ULCERS\*

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IT appears to be the general impression, especially among medical men, that a relatively large number of patients suffer as much after a gastro-enterostomy as before the operation. Yet the proportion of unsuccessful cases from the standpoint of ultimate results seems always to be a matter of impression rather than of fact. An effort to estimate the relative frequency of the poor late results and to determine some of their causes is the object of this paper. Three explanations of the failures immediately suggest themselves; first, that the operation was improperly performed in the unsuccessful cases; second, that the operation was wrongly elected in these cases; third, that gastrojejunostomy is inevitably and inexplicably unsuccessful in a certain proportion of cases.

Technical errors dependent upon such features as the size and situation of stoma, length of loop, type of suture material and imperfect approximation of the mucous membrane edges are undoubtedly responsible for the poor late results in some cases, as will be noted in connection with the fluoroscopic examinations; yet the operation in recent years has been so nearly standardized that these factors probably are responsible for only a relatively small proportion of failures.

The question arises then as to why some gastro-enterostomies, presumably performed in a proper manner, should prove unsuccessful. We have sought an answer through a review of the late results in a consecutive series of cases performed by one of us at the New York Hospital from April, 1914, to 1922. During that period accurate records were kept as to the operative findings, especially the site of the ulcer. In a previous article † the cases from January, 1912, to April, 1921, were presented, but those prior to April, 1914, have been omitted from this series because in some of the early records the site of the ulcer is not stated.

There were seventy cases of posterior gastro-enterostomy for ulcers of stomach or duodenum. In a small proportion something in addition to the gastro-enterostomy was done. The operation was always the short loop type with suture, clamps being employed. Linen was used as the outer layer in about 25 per cent. of the cases. Two of the series developed gastrojejunal

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† Journal Medical Society, State of New Jersey, vol. xviii, 1921, p. 214.

ulcers, one with the linen suture showing on the floor of the ulcer. In recent years chronic gut has been employed exclusively. No rule has been followed as to the direction of the stoma, but it has been made to conform as nearly as possible to the apparent direction of the first part of the jejunum, deviating somewhat from the vertical to the right or left.

Of the seventy cases seventeen were gastric, fifty duodenal; in three, which may be termed "parapyloric," it was not determined whether the ulcer was gastric or duodenal.

The mortality was six. Four occurred in duodenal ulcers and two in gastric. In five, gastro-enterostomy only was done; in one pylorectomy. The deaths were due to delirium tremens, mastoiditis with septicæmia, death on twenty-fifth day, peritonitis, pulmonary embolus, intestinal obstruction; unexplained in one dying on fifth day, although an autopsy was performed.

Sixty-four patients were discharged from the hospital and sixty have been traced, or  $93\frac{3}{4}$  per cent. One of the patients was killed shortly after leaving the hospital, consequently only fifty-nine cases are reported. These cases have been followed for varying lengths of time. One followed over seven years; ten between six and seven years; four between five and six years; seven between four and five years; two between three and four years; eight between two and three years; seventeen between one and two years; ten less than one year. The average time was about three years.

In following these patients particular consideration has been given to the general physical condition, weight, appetite, digestion, bowels, gastric analysis and fluoroscopic examination of the stomach. Such features as pain, feeling of distention, eructation, nausea, vomiting and diarrhoea have been carefully inquired into.

Of the fifty-nine cases traced, forty-two have been fluoroscoped by Doctors Holland and Dineen. The patients come to the hospital at 10 A.M., having taken a cathartic the night before and fasted since midnight. The fasting contents are expressed, the large stomach tube being used, as the duodenal tube slips too easily through the gastro-enterostomy stoma. A test meal is then given, expressed and analyzed. A liquid lunch is taken at noon and the patient is fluoroscoped at 4 P.M. In the examination the screen is quickly passed over the heart, lungs and abdomen, and then the patient is given the first glass of barium. The second glass is given later when by pressure an effort is made to cut off the gastro-enterostomy stoma, so that the pylorus can be studied. The fluoroscopic examinations are made in the upright position and therefore the conditions more nearly approximate those which prevail after taking food than examinations made when the patient is recumbent. The fluoroscopic observation of the stomach in action likewise would appear to give more exact knowledge than X-ray plates which register momentary phases. Twenty-four of the forty-two cases fluoroscoped ‡ had

‡ We have disregarded associated operations on gall-bladder, appendix etc.

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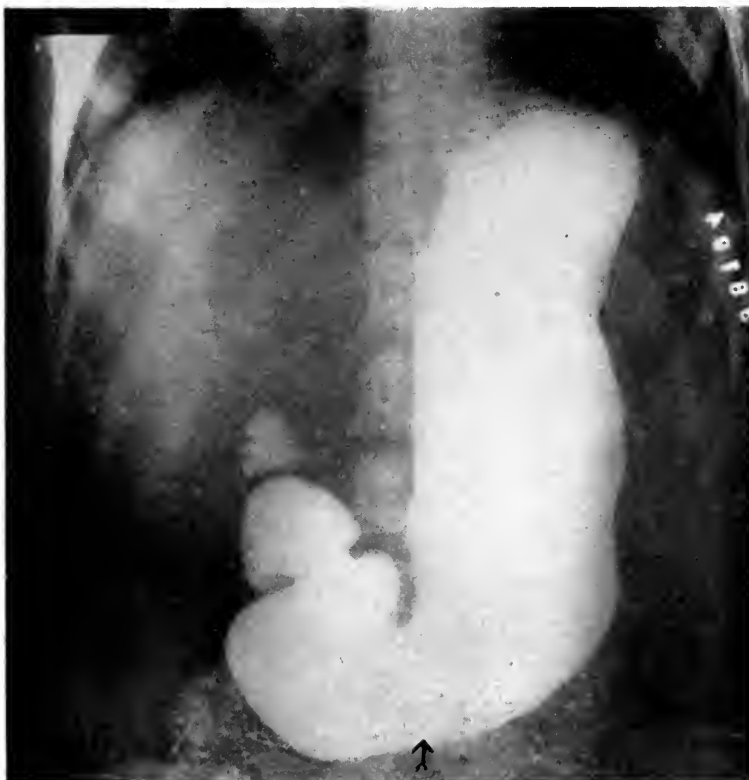


FIG. 1.—Situation for properly placed stoma, its position corresponding to downward prolongation of vertical portion of lesser curvature.

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only a posterior gastro-enterostomy performed and showed good results, and in these cases the following features were noted:

1. The stoma regularly was at the most dependent portion of the stomach just to the left of the midline, its situation corresponding to the downward prolongation of the vertical portion of the lesser curvature (Fig. 1). A stoma in this position empties the stomach efficiently and quickly.
2. There was diminished gastric peristalsis.
3. The barium immediately began to pass out by way of the gastro-enterostomy opening.
4. The pylorus was patent under pressure. In most of the cases no barium passed the pylorus except under pressure. In a few, small amounts passed spontaneously. Our findings differ in this respect from those of most observers.
5. It averaged about twenty-five minutes for all the barium to leave the stomach.
6. In none of the cases did the stoma close.

The above observations present the conditions which we noted in satisfactory cases.

Examination of those cases in which the pylorus had been occluded by kangaroo tendon tied around it, as well as those in which the ulcer had been inverted or the pylorus narrowed with sutures, ultimately showed the pylorus open to the extent that barium could be forced through under pressure. Fluoroscopic examination of those cases in which the pylorus has been divided revealed a pouch at the pylorus, with a well-functionating gastro-enterostomy.

The results of gastric analyses will not be reported since our findings coincide with those of Patterson and others who have shown that a diminished acidity is the rule.

A. L. Holland has kindly prepared the following analysis of fluoroscopic findings after gastro-enterostomy based on the study of a large number of cases by various operators. He has thus had opportunities to observe a considerable number of patients who were not cured. His findings in these are of interest.

1. In the apparently cured cases the fluoroscope usually shows a stomach of slightly less tone than before the operation, the stoma placed in the most dependent position, the opening being sufficiently wide to allow a fairly good-sized stream of opaque material to pass into the jejunum, but not so wide as to drain the organ at once. In these cases the antrum and first portion of the duodenum (cap) can usually be filled out with the opaque material but only under prolonged pressure and manipulation. In these cases the first portion of duodenum usually does not fill spontaneously, at least during the ordinary fluoroscopic observations.

2. In those cases that have been only partly relieved of their ulcer symptoms, the fluoroscope may show conditions to be ideal, as described in the preceding group, but in most of them the stoma has not been placed in the most dependent position or is too far to the left, or too near the antrum, or too small, or even not patent. A stoma placed too far to the left seems especially bad. Frequently

in such cases a small residue is left in the most dependent portion of the stomach. This seems to act as an irritant, causing spasm of the pars pylorica, hence the continuance of the ulcer syndrome.

3. In those cases of the third class (the failures) the stoma may be absent at the fluoroscopic observation or too small or not placed in the dependent portion, as described in the preceding group. In not a few the conditions observed fluoroscopically would seem to be ideal. In such cases one is justified in suspecting a marginal ulcer; but here the symptoms are apt to be somewhat different from the original symptoms complained of before the operation.

4. A large percentage of those cases that present symptoms of irregular type can probably be called post-operative or secondary neuroses. In perhaps a large majority the conditions fluoroscopically observed are ideal. In a small percentage the stoma has been found so large that the stomach has drained immediately. This has probably resulted in an intestinal indigestion which has caused the irregular symptoms such as loose bowel movements and gas pressure in the abdomen. In several such cases the loop seemed to be unusually long.

Holland believes that pain is the most reliable evidence of ulcer activity, and is dependent upon increase in tension in the zone of the ulcer. This increase in intragastric tension is made evident by the character of the peristalsis and the general tone of the organ. In the early cases, the increase in peristaltic activity and tension tends to overcome any obstruction and a residue is thus prevented but sooner or later as decompensation becomes established a residue is inevitable. The first effect of a gastro-enterostomy is the lowering of the tension throughout the stomach, in this manner preventing undue peristaltic activity in the parts adjacent to the ulcer. And this would seem to be upheld by the fluoroscopic study of such cases, as the tension, and therefore the peristaltic activity, in the satisfactory cases seems always to be considerably less after the operation.

In those cases where the results have been so satisfactory one can frequently detect considerable tension, particularly in the antrum and pars pylorica, due either to the irritation of a residue or the efforts of the stomach to propel the chyme through a small stoma.

Good results in this operation do not seem to depend upon the complete occlusion of the pylorus, as in practically all cases the antrum and duodenum (cap) can be filled under pressure. But where the opaque chyme tends to pass through the pyloric exit rather than the stoma, the results are usually not lastingly satisfactory. When the barium passes through the pylorus, in unsatisfactory cases at times reverse peristalsis or other erratic behavior may be noted in duodenum. In these cases a slight kinking at the side of the stoma may not bring about a serious obstruction but yet be sufficient to produce gastrointestinal symptoms of a pronounced character, and occurring with definite relation to meals they may easily be mistaken for the recurrence of an ulcer.

*Late Results.*—Of the fifty-nine patients followed, fifty were well at the last report and experienced no discomfort or untoward symptoms. In recent years we have appreciated the importance of after-treatment and have urged a routine life and diet and medical supervision for a long period. The observance of this precaution appears to have improved the results.

The patients are instructed to take small meals frequently, so as not to have the upper intestinal tract unduly filled at any time nor empty for long periods. Therefore, instead of three large meals daily, they follow a routine



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somewhat as follows: 8 A.M. breakfast; 10 A.M. milk and crackers; noon lunch; 4 P.M. milk and bread; 7 P.M. dinner; 10 P.M. milk and crackers or 5i sodium bicarbonate in glass of warm water.

A diet slip is given the patients but the diet is not restricted to a marked degree. The patients, however, are particularly instructed to avoid the following: Alcohol; foods fried in grease, which are not readily digested; condiments, beef extracts, and such things which unduly stimulate gastric secretion. It is explained to the patients that since the food is only in the stomach for a brief period, it should be slowly and thoroughly masticated. A glass of warm water with 5i sodium bicarbonate should be taken before retiring.

Nine of the cases have been reported as unsatisfactory, two of these presenting gastrojejunal ulcers. It is of interest to note that we have had in this same period three other marginal ulcers in cases originally operated upon elsewhere.

The employment of gastro-enterostomy for gastric ulcer need not be discussed at length since it is generally accepted that this operation alone should be elected in gastric ulcers only for the relief of obstruction. Such ulcers should, if feasible, be removed, in conjunction with which gastro-enterostomy is often advisable.

There were seventeen cases, nine within two inches of pylorus and six at a distance of more than two inches. There were two operative deaths (one gastro-enterostomy, one pylorotomy). Gastro-enterostomy alone was done in eight patients whose condition did not seem to warrant more radical measures. One died of intestinal obstruction; five showed ante-operative retention of six hours or more, and gave good results. The two without retention showed one poor result and one unknown. The other nine cases had gastro-enterostomy plus some other procedure, as removal of ulcer in three, all good results, followed three to five years; partial gastrectomy six, one died of peritonitis, three gave good results two to six years, two later developed pulmonary tuberculosis. The gastric cases are so few that no deductions can be drawn; it is of interest, however, that the five cases with definite retention have done well after gastrojejunostomy alone, one for six years; two for four years; two for one and a half years.

In duodenal ulcers the indications for removing the ulcer are far less striking and gastro-enterostomy as the sole or principal feature of treatment must be considered. Some surgeons appear to employ it as routine, others decry it for most cases. While it is evident that the large proportion of patients are cured by the operation, some cases in which the procedure has been employed are symptomatic failures. Efforts should be directed to the determination of what proportion of cases are successful and if possible what types of cases fail to be benefited. If these questions could be answered, definite indications might be laid down as to when the operation should be employed and when avoided.

There were fifty cases of duodenal ulcer with six unfavorable late results. In thirty-two, gastro-enterostomy only was performed with two poor results.

CASE I. Male, forty, April, 1917, very weak, repeated vomiting of blood, hæmoglobin 36; transfusion, no X-ray; gastro-enterostomy. No ulcer recognized. Well for two years, then had a severe hemorrhage. Fluoroscopic examination indicates a duodenal ulcer, but patient refuses operation. Digestion and general health have been good.

CASE II. Woman, forty, December, 1921, symptoms and X-ray suggestive of duodenal ulcer, four-hour residue but no six-hour retention. Operation. Gall-bladder contained stones, cholecystectomy; first part of duodenum covered by dense adhesion; induration in wall of duodenum suggested ulcer but this was not positively established gastro-enterostomy. Now has occasional attacks of vomiting. Fluoroscopic examination shows stoma functioning well. Operation was so recent (4 months) that the ultimate result is somewhat uncertain.

In nine gastro-enterostomy plus inversion of ulcer; one poor result.

CASE III. Male, forty-one, indurated duodenal ulcer found at operation, no six-hour retention by X-ray. Well for two years after operation, since then has had pain in epigastrium beginning about three hours after meals; nausea; food or bicarbonate relieve pain. Has lost 10 pounds.

In one gastro-enterostomy plus excision of ulcer.

In three gastro-enterostomy plus ligation of pylorus with kangaroo tendon. Two poor results.

CASE IV. Male, forty-three, April, 1915, developed recurrent gastrojejunal ulcers. The stoma was twice reconstructed with excision of ulcer. Such recurrences apparently are not rare and therefore it appears best in such cases to disconnect the stoma entirely, doing a pyloroplasty if pylorus is stenosed or ulcer unhealed.

CASE V. Male, thirty-one, March, 1916, no six-hour retention. Recurrence of same symptoms as before operation; much epigastric pain, nausea, and vomiting after meals. Explored by another surgeon seven months after operation, stoma found patent, adhesions freed, well for six months then recurrence of all symptoms.

In four, gastro-enterostomy plus section of pylorus (von Eiselsberg), one poor result.

CASE VI. Emaciated young woman. Gastric symptoms relieved but diarrhœa has persisted for the seven years and requires morphine.

In one, gastro-enterostomy plus infolding of pylorus by suture.

The last three procedures were employed only in the early cases of the series.

Forty-five of the fifty unquestionable ulcers. Five belonged to that perplexing type with ill-marked, outward and visible signs of ulcer on exposure of duodenum, and although it was believed on the basis of the operative findings that an ulcer was present, this was not positively established. It is

notable that of the six cases reported above as poor results, four belonged to this group, the fifth has not been traced. Four of the five were done in the first two years of the series—that is, before 1916. The importance of avoiding an unnecessary gastro-enterostomy is such that in recent years it has been our practice to open the duodenum for exploration in such doubtful cases to prove or disprove the existence of an ulcer. It is almost universally agreed that a gastrojejunostomy in the absence of obstruction should never be done unless there is definite proof of an ulcer. By an exploratory incision into duodenum unnecessary gastro-enterostomies have been avoided in a number of our cases. In only one case, however, has a doubtful ulcer been verified by incision. Yet, in some cases microscopic examination of the tissue removed from a suspected area has revealed the duodenitis described by Judd.

In a previous analysis (*l. c.*) we found 18 per cent. failures in forty cases of parapyloric ulcers, that is those close to pylorus, which had been treated by gastrojejunostomy. The duodenal and gastric were not differentiated. We found that all of those which showed six-hour barium retention before operation were successful; whereas in those without six-hour retention there were 33 per cent. failures after gastro-enterostomy.

In the present series of duodenal ulcers the failures are so few that figures bearing upon this phase cannot be presented without unduly exaggerating the importance of a very small number of cases. It is significant, however, that at no time have we had a case presenting six-hour retention before operation which gave an unsatisfactory late result, whereas of the six unsatisfactory results four occurred in the fifteen cases in which there is a definite statement as to the absence of six-hour barium retention. In the other two there was no six-hour X-ray record.

Accumulated evidence indicates that a well-placed gastro-enterostomy is a fairly reliable procedure for the treatment of duodenal ulcer, but that unsatisfactory results may be expected to ensue in a small proportion of cases. Apart from the failures due to improperly placed stomas the reliability of the operation for permanent relief of the patient appears to be somewhat proportionate to the degree of pyloric stenosis. For this assumption the following explanation is suggested:

In many ulcers near the pylorus there develops some degree of pyloric obstruction which in part is due to cicatricial contracture and in part to pylorospasm. This narrowing of pylorus excites a more or less violent compensatory response from the gastric musculature to overcome the increased pyloric resistance. This is evidenced by increased peristalsis, which can be recognized fluoroscopically, and later by delayed emptying of the stomach. A six-hour retention, especially on several examinations, represents a fairly well-marked degree of this abnormal condition. Drainage by gastro-enterostomy immediately causes relief. Subsequent to operation little of the stomach contents pass through the pylorus, according to our fluoroscopic

observations, and conditions are established favorable for repair of a duodenal ulcer.

In cases without pyloric contracture or constriction, the immediate relief is often less marked. But here, too, almost the whole flow of gastric contents, when the stoma has been properly placed, is ordinarily through the stoma, moreover gastric peristalsis and intragastric tension are reduced, therefore conditions are favorable for the repair of the ulcer. The immediate results in both groups are usually satisfactory since a good stoma evacuates the stomach. But ultimately some of the cases do badly; those with a real organic stenosis extremely rarely, those with a fully patent pylorus occasionally. These ultimate failures constitute the feature which causes the most anxiety. They are evidently due in some cases to contraction of stoma, with passage of a considerable proportion of gastric contents through the pylorus. Recurrence of symptoms may then be due to an incompletely healed ulcer or to interference with the progress of the chyme from duodenum into jejunum by the hitching up or angulation of the jejunum at the stoma. This condition would probably not be prevented by any measure intended to block the pylorus except its division, which is not advisable; ligation and such measures exert only a temporary effect. These late disturbances can apparently be avoided only by a more careful selection of the cases appropriate for gastro-enterostomy.

#### SUMMARY

A well-placed gastro-enterostomy empties the whole stomach adequately and quickly. If fluoroscopic examination shows incomplete or tardy emptying a technical fault may ordinarily be inferred. Even a well-placed stoma occasionally is associated with serious sequelæ. First, there is always an appreciable risk of a gastrojejunal ulcer, variously stated as from 2 to 3 per cent. Second, symptomatic failures occasionally occur. In chronic indurated ulcers, especially those with some grade of pyloric obstruction, as represented by six-hour barium retention, symptomatic failures have not been experienced. The rare symptomatic failures apparently occur after gastro-enterostomies for small non-obstructing ulcers. It is our practice in all cases of suspected duodenal ulcer to determine before operation whether a six-hour barium retention is present. If such exists we feel that a gastrojejunostomy is unquestionably justifiable if an ulcer is found at operation. If no six-hour retention is noted, we endeavor to avoid a gastro-enterostomy, although this is not always done, especially in large indurated ulcers. If there is uncertainty after exposure of the duodenum as to the existence of an ulcer, the lumen is opened and the mucous membrane explored. When a small non-obstructing ulcer has been demonstrated, either with or without the aid of this exploratory incision into the duodenum, an appropriate plastic operation on pylorus or duodenum, if feasible, with excision of the ulcer, is elected in preference to a gastrojejunostomy.

*Acute Perforations.*—The foregoing impressions in regard to gastrojejunostomy have a definite bearing upon an important factor in the treatment of acute perforated ulcer, namely whether a gastro-enterostomy should or should not be made at the initial operation. A brief analysis of our cases will explain this feature. The series comprises fifty-nine cases of acute perforated ulcers of stomach or duodenum for which we have been directly responsible either at New York or Hudson Street Hospitals since 1910. Some have been operated upon by our associates on the Second Surgical Division.

There were fifty-eight males and one female. The ages ranged from eighteen to sixty-five, but 90 per cent. were about equally distributed between the third, fourth and fifth decades of life. There was a mortality of eleven, seven from peritonitis, one from pneumonia, one from pulmonary embolus, one from multiple abscesses of the liver, and one from pelvic and subdiaphragmatic abscesses. The length of time between the perforation and the operation was of striking significance in the mortality. Thus, in forty cases operated upon within six hours after the perforation there were no deaths; there were four deaths in nine cases operated upon between six and twenty-two hours after perforation and seven deaths in nine cases operated later than twenty-two hours. In thirty-four (57 per cent.) of the patients there was a definite history of gastric symptoms for a period of one year or more. An incorrect diagnosis was made seven times; six times acute appendicitis; once cholecystitis. In all except three of the cases the perforation was on the anterior surface of the duodenum or stomach close to the pylorus.

A primary gastrojejunostomy was made in only nine of the cases. In these there appeared to be undue constriction of the pylorus after suture of the perforation. All were cases operated upon early and none died. In later cases the risk of obstruction was considered less than the danger of prolonging the operation by adding a gastrojejunostomy. Apparently none of the eleven deaths resulted from obstruction of the pylorus and analysis of the fatal cases fails to show any in which it is probable that gastro-enterostomy would have saved the patient. This throws doubt upon the necessity for the gastro-enterostomy in the nine cases in which it was elected, and likewise upon the contention that routine initial gastro-enterostomies will diminish the mortality.

Thirty-six of the patients have been followed for periods of one to six years, one additional patient for six months. This case was operated upon six months ago and at the initial operation a primary gastro-enterostomy was made; he developed a lung abscess for which he was recently operated. The result of the gastro-enterostomy is uncertain, therefore the case will not be included in the tables.

The late results in those followed who did not have a primary gastro-enterostomy show twenty-one out of thirty-one well and free from symptoms; ten had recurrence of gastric symptoms. Seven of these have been reoperated and a gastro-enterostomy done. They had developed pyloric obstruction with

gastric retention. Of the seven, six have been completely cured, one improved. The other three still have symptoms, but have had no further surgery.

The late results of those who had a primary gastro-enterostomy show three well and free from symptoms; two had recurrence of gastric symptoms; in four the result is unknown. Of the two failures, one developed a gastrojejunal ulcer and had a reconstruction of the stoma. He is now relatively well. The second has had attacks of nausea, eructations of gas and vomiting. The number of cases followed after primary gastro-enterostomy are so small that this group will not be considered in the conclusions, although two out of the five followed showed poor late results.

Our observations are not favorable to routine initial gastro-enterostomy for the following reasons:

Primary gastro-enterostomy, as performed by the average surgeon, probably increases somewhat the immediate operative risk; but its chief disadvantage is that it exposes the patient to the untoward sequelæ of gastro-enterostomy; that is, symptomatic disturbances and gastrojejunal ulcers. Symptomatic failures follow gastro-enterostomy for parapyloric ulcers in about 20 per cent. of the cases. Gastrojejunal ulcers have been variously reported as occurring in 2 to 3 per cent. of all cases.

Our figures indicate that two out of three cases do well after closure alone; that one in three cases after closure of the perforation only later develop pyloric obstruction. This demands operation. But a definitely indicated late gastro-enterostomy on one-third of the cases is preferable to subjecting all the cases to prophylactic gastrojejunostomies at the initial operation. Since two-thirds of the patients do well without a gastro-enterostomy these would be subjected unnecessarily to the possible dangers and discomforts of the operation, namely peptic ulcer and symptomatic gastric disturbances. Closure of perforation with care in placing the sutures so as to avoid undue obstruction of the pylorus appears to be the best general procedure. Gastrojejunostomy must, however, be employed in those infrequent cases in which there is evidently marked diminution of the lumen after suture of the perforation.

Post-operative therapy is most important, particularly diet and observation for a long period. With more care in the operative procedure and the proper regulation of these cases after operation, especially as to diet, the percentage of good results should be increased.

# THE END RESULTS OF OPERATIONS FOR GASTRIC AND DUODENAL ULCER AND CANCER\*

BY GEORGE W. CRILE, M.D.

OF CLEVELAND, OHIO

My associates in the Cleveland Clinic and in the Lakeside surgical service have performed 761 operations upon the stomach and duodenum. In the early records we find that the data are too incomplete to be of value for statistical study. Furthermore as this is the first time that we have systematically addressed inquiries to these patients, we were disappointed to find how many could not in our first attempt be traced. As the Bureau of Statistical Research of the Cleveland Clinic will continue indefinitely, we expect the list of traced cases to be greatly augmented. We are able, however, to present the following data regarding 560 cases, including:

Carcinoma of the stomach .....	189 cases
Carcinoma of the duodenum .....	5 cases
Sarcoma of the stomach .....	2 cases
Ulcer of the stomach .....	159 cases
Ulcer of the duodenum .....	200 cases
Tumors of the stomach (undifferentiated) .....	5 cases
Total .....	560 cases

As to the immediate results of operation we find in our earlier series the mortality was formidably high, but that in our last 108 cases of gastro-enterostomy and resection we have adopted methods of management and of technic based on biophysical concepts elsewhere published, embracing in particular anticipatory intervention—that is, treatment and management to forestall danger—the indication being based on statistical probabilities rather than on established indication of the case in hand. This includes blood transfusion in advance; 5000 c.c. saline solution; analgesia in bad risks; hot packs to abdomen, as a result of which the protection of the patient is increased.

In this series of 108 operations there was a mortality rate of two and eight-tenths per cent. In simple gastro-enterostomy alone the mortality is under one per cent.

Among the 560 cases which are the subject of this study, 450 came to operation; and exploratory operations only were done in ninety-nine, the condition being found to be inoperable.

The operations employed in our total series have included: Eighty-one two-stage and temporizing operations, 302 gastro-enterostomies and forty-eight resections of the stomach.

In an effort to trace the later course of these cases it has been possible

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\* Read before the American Surgical Association, May 2, 1922.

GEORGE W. CRILE

to secure information regarding 325 patients. Among these, forty-nine deaths since discharge from the hospital have been reported, the length of life of those that have died is as follows:

CASES DYING AFTER LEAVING HOSPITAL

Carcinoma of the stomach—33 deaths.

Less than 1 year ..... 23 (including 11 inoperable cases)  
 1-2 years ..... 1  
 3-5 years ..... 2  
 Not known ..... 7 (including 3 inoperable cases)

Ulcer of the stomach—6 deaths.

Less than 1 year ..... 2  
 3-5 years ..... 1  
 Not known ..... 3 (including 1 inoperable case)

Ulcer of the duodenum—10 deaths.

Less than 1 year ..... 1  
 More than 5 years ..... 2  
 Not known ..... 7 (including 2 inoperable cases)

TABLE I

*Living Cases after Operation for Duodenal and Gastric Cancer and Ulcer*

	Under one year	One to two years	Two to three years	Three to five years	Over five years	Total
Carcinoma of the stomach ..	15	13	1		6 including 1 for 10 years 1 for 14 years 1 for 16 years 2 for 20 years	35
Carcinoma of the duodenum		1		1	1 for 10 years	3
Ulcer of the stomach.....	27	19	2	5	17 10 for from 5 to 10 years 7 for from 10 to 15 years	70
Ulcer of the duodenum....	62	27		2	27 23 for from 5 to 10 years 4 for from 10 to 12 years	119
(Length of life undesignated.....1)						

Attempts to elicit information bearing upon the subjective, comfort and the economic status are at best unsatisfactory unless the inquirer can person-



ally see the patient. Questionnaires, however, will often bring out significant points.

A questionnaire was sent to all cases operated upon more than one year ago and sixty-six replies have been received.

Eighty-two per cent. have reported that their symptoms were relieved; eleven reporting present discomfort. Eighty-five per cent. stated that they were able to resume their normal occupation or normal daily routine in less than six months after operation. Sixty-five per cent. have not been under any treatment for "stomach trouble" since operation, while twenty-two state that they have received some post-operative treatment. Two report subsequent surgical treatment.

Of especial value is the definite report of a gain in weight of thirty-one patients, the gain varying from three to sixty-two pounds, with a gain of more than ten pounds in twenty-seven cases. Seven report a definite loss in weight.

Thirty-eight report their present state of health as "good"; twenty-five as "fair," while four admit "poor" health at the present time.

As to the choice of operation, no general rule can be adopted, as in each case the extent of the resection or the choice between an anterior or a posterior gastro-enterostomy, a Polya, a Moynihan, etc., depends upon the situation in the individual case. By present methods the operability is limited only by anatomic considerations. Division of the operation into successive seances with the interoperative periods employed for the restoration and increase of the patient's reserves extends the operability of all cases to include all but those in which the growth has extended beyond the possibility of anatomic removal and repair.

This is presented only as a preliminary and tentative report. The study of our past cases is still in progress. The results of a more complete study will be offered later.

Several impressions have been gained:

1. The operative mortality is now reasonably in hand.
2. The patient as a whole, no less than the local ulcer, should be considered—namely, focal infections; auto-intoxication; readjustment as to work and rest; habits of eating and type of food should be considered—that is to say, the patient as a whole should be considered.
3. Duodenal ulcers give better results than gastric.
4. Vicious cycle is no longer seen.
5. Peptic ulcer appears in proportion to the curative effect of the treatment. It is a part of the disease rather than a result of the operation.
6. In general, we believe that a Sippy routine should be first tried in the acute cases and if ten days or two weeks do not give definite improvement, then operation should not be delayed.

# THE RESULTS OF THE OPERATIVE TREATMENT OF CASES OF CHRONIC GASTRIC AND DUODENAL ULCER AT THE MASSACHUSETTS GENERAL HOSPITAL CLINIC\*

BY CHARLES L. SCUDDER, M.D.  
OF BOSTON, MASS.

At the surgical clinic of the Massachusetts General Hospital, there are available for study the records of 310 chronic ulcers of the stomach and duodenum.

This is an important group of cases, because each case was studied by the special gastro-enterologic clinic of Dr. Henry F. Hewes, or by the medical house service under Dr. David Edsall, Dr. William H. Smith and Dr. F. T. Lord, and in some instances by both services and in all instances by the röntgenologic service of Dr. George Holmes. Operation was done in each instance by a former or present member of the surgical staff of the hospital. Each member of the staff is a member of this Association.

There is a total of 310 cases in which the evidences of a chronic indurated ulcer were definitely seen and demonstrated.

*Gastric Ulcer Cases.*—There were 171 gastric ulcers.

There were twelve post-operative deaths and six autopsies. An immediate mortality of 7.6 per cent. Causes of death:

	Cases
Pneumonia .....	4
Peritonitis .....	2
Hemorrhage .....	2
Septic parotitis .....	1
Embolism .....	1
Persistent vomiting .....	2

One with autopsy, bloody urine and casts; fatty liver, icterus; pyloroplasty.

One without autopsy; pylorectomy.

The remote results of operation upon these 171 cases are known in 108 cases.

The time elapsed after operation until the observation of the present condition is one year to sixteen years.

Ninety-nine cases out of the 108 were practically well.

Nine cases were having symptoms of dyspepsia or indigestion similar or somewhat similar to the old trouble.

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\* Read before the American Surgical Association, May 2, 1922.

## GASTRIC AND DUODENAL ULCER

Among the ninety-nine well cases a few have reported that, attributable to error in diet, a little sour stomach or gas would bother, but it was corrected by attention to diet.

In other words, the distressing situation preceding operation had been eliminated. Continuous good health obtained.

	Cases
1 year .....	19
2 years .....	25
3 years .....	33
4 years .....	10
5 years .....	8
6 years .....	3
7 years .....	7
11 years .....	1
14 years .....	1
16 years .....	1
<hr/>	
Total .....	108

In this connection it is significant that these 108 individuals had suffered from dyspepsia and indigestion sufficiently severe to need constant or intermittent medical advice for years, averaging five to ten years.

In other words, this group of gastric ulcer cases is a group in which the clinical picture is a long and distressing one; in which the lesion demonstrated is typical of the old infected chronic indurated ulcer. A few of them had had severe hemorrhages; a few had a subacute or chronic perforation; many of them had disturbed motility of the gastric musculature; many of them had a disturbed chemistry of the stomach; in all of them the general health was affected by the pathology.

The operative procedures followed in the gastric cases were:

	Cases
Gastro-enterostomy .....	47
Excision alone .....	6
Excision and gastro-enterostomy .....	13
Cautery and gastro-enterostomy—Balfour .....	14
Sleeve resection .....	3
Gastrogastrostomy .....	1
Pyloroplasty .....	1
No plastic, division of adhesions .....	2
Partial gastrectomy .....	21
<hr/>	
Total .....	108

In more than half the cases an excision or partial gastrectomy was done, *i e.*, a direct attack was made upon the ulcer.

*Duodenal Ulcer Cases.*—There were 139 duodenal ulcer cases.

# CHARLES L. SCUDDER

There were nine post-operative deaths; six per cent. mortality—immediate.  
Causes of death:

	Cases
Pneumonia .....	1
Peritonitis .....	3
Hemorrhage .....	1
Embolism .....	2
Shock .....	1
Cardiac .....	1
	—
Total .....	9

Three autopsies.

The remote results are known in ninety-four cases.

The time elapsed after operation is from one to ten years, as follows:

	Cases
1 year .....	24
2 years .....	23
3 years .....	25
4 years .....	12
5 years .....	4
6 years .....	2
7 years .....	3
10 years .....	1
	—
Total .....	94

Eighty-eight cases out of the ninety-four were practically well.

Six cases had troubles of digestion without diet and were not completely relieved.

The operative procedure followed in the duodenal cases was infolding of the chronic ulcer and a posterior gastro-enterostomy, with a plastic of omentum to the peritoneal surface of the ulcer. Occasionally cauterization of the ulcer accompanied the gastrojejunostomy.

*Summary.*—One hundred and eight chronic gastric ulcer cases—ninety-nine cases well, 91.7 per cent.; nine cases not well.

Ninety-four duodenal ulcer cases—eighty-eight cases well, 93.6 per cent.; six cases not well.

General mortality of the whole group, 310 cases, 6.7 per cent.

This group of cases is a general hospital group. None of the cases occurring in the private clinics of the surgeons operating upon this group are included here.

## PEPTIC ULCER\*

BY JOHN B. DEAVER, M.D.  
OF PHILADELPHIA

PEPTIC ulcer continues to demand the attention of internist and surgeon alike, to say nothing of the victims of this annoying and debilitating condition. It is gratifying, however, to be able to record that surgery continues to offer the only prospect of a cure in an ever-increasing number of cases. Of a group of 600 cases, fifty of which, recently followed at the Lankenau Hospital, we learn that complete cures were obtained in eighty per cent., that is, entire relief of symptoms without any signs of recurrence. Some of these patients were operated upon as many as sixteen years ago. The majority, however, were operated since that time.

There is also a class, comprising about sixteen per cent. of the cases, who are markedly benefited by operation, although still suffering from an occasional attack of some more or less severe gastric disturbance but who frankly state that these attacks are entirely controllable by proper attention to diet, to hygienic and regular modes of life. Taking the above two classes together, it may be said that ninety-four per cent. of the cases under consideration have been decidedly benefited by operation. This leaves the comparatively small number of six per cent. who fail to be relieved by surgery.

The most common cause for the recurrence of ulcer symptoms is marginal ulcer or the development of a new ulcer. As to marginal ulcer, I believe it is the general experience that the unpleasant sequel is to be expected to take place in from one to two per cent. of operated cases. Diathesis seems to play a part in the development of marginal ulcer, since I have observed that it usually occurs in patients who, before operation, presented a very high free as well as a very high total acidity. It is in these cases that persistent post-operative treatment is particularly indicated. I have had the experience of having one patient return three times for the relief of marginal ulcer.

Diathesis also seems to be a factor in the persistence of ulcer symptoms after operation. But very often it may be due to some focus of infection residing more particularly in the gall-bladder or in the appendix. The following is a typical instance.

The patient (No. 3550/20) was operated upon at the Lankenau Hospital October 28, 1918, for ulcer symptoms of twenty years' standing. At the operation an ulcer was found at the fundus of the stomach and excised through an anterior gastrotomy. No other pathology was noted and no other operation was done at this time. The patient remained well for two years, following which the ulcer symptoms returned, accompanied by marked loss of weight. At the second operation, November

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\* Read before the American Surgical Association, May 2, 1922.

24, 1920, a crater-like mass was found at the lesser curvature of the stomach, necessitating a sleeve resection and end-to-end anastomosis. For some reason the appendix was not removed at this time. Five days later the patient developed acute appendicitis, and at operation an acute, perforating, gangrenous appendix was removed. After this, recovery was uneventful. This patient reported in person to our Follow-up Clinic in January, 1922, entirely relieved of the conditions for which the operations were done. He was able to return to work one month after leaving the hospital and had practically regained his health and strength.

Sometimes patients who do not benefit by operation report a recurrence of bleeding. Of course, in the presence of a new ulcer the cause for the hemorrhage is apparent. Occasionally, however, it may be due to focal infection from a diseased gall-bladder, or a diseased appendix not removed at the time of the ulcer operation, and sometimes also from a pancreatitis which develops after the original operation. Bleeding following operation for duodenal ulcer located upon the inner wall of the second portion of the duodenum where excision of the ulcer cannot be made is not to be unexpected. I have in mind a patient operated upon in December, 1911, where the induration of a duodenal ulcer extended to and involved the head of the pancreas. The outer wall of the duodenum was infolded over the ulcer and a posterior gastro-enterostomy done. The patient remained perfectly free from symptoms until about three months ago, when he was seized with a severe hemorrhage, vomiting bright red blood. The bleeding fortunately yielded to medical measures, but the ultimate outcome is still a matter of doubt.

In a few instances ulcer patients return for operation on account of intestinal obstruction. While this may be the result of adhesions, it is more likely to be caused by incarceration of a knuckle of gut between the margins of the anastomosis and the opening in the transverse mesocolon. This, of course, is largely a matter of surgical technic which can be avoided by suturing the anterior and posterior margins of the opening in the transverse mesocolon to the stomach.

Making the operation suit the case is, of course, an important item in the end-results. Excision of the ulcer wherever possible and a posterior gastro-enterostomy is still, in my opinion, the operation of choice. I was able to do this in forty-five per cent. of the patients among those who reported complete cures. Excision in some instances was done with the cautery, but in most it was done with the knife.

In certain cases where the stomach has not lost its motility and where there is no perigastritis, pyloroplasty may be indicated, but none of the cases in this series of fifty were so treated.

Radical operation for peptic ulcer, especially for ulcer of the stomach, is gaining favor. This was the choice of twelve per cent. of the series of cured cases. It consisted either of a sleeve resection, a pylorectomy, or a subtotal

## PEPTIC ULCER

gastrorectomy. One of the latter had been done in 1910 and the patient is still in perfect health. In our experience the sleeve resections cause the least anxiety.

There is a tendency to minimize the value of posterior gastro-enterostomy as of itself capable of curing peptic ulcer in many cases. It certainly does procure complete relief of symptoms for a period of time. This is evidenced by the fact that of the cases in which the ulcer was not excised and in which only a posterior gastro-enterostomy was done, eighteen per cent. reported freedom from symptoms for one to five years after operation.

To return to the question of excision of the ulcer, excision, of course, removes the menace of hemorrhage, perforation, and finally of malignancy. No matter what the percentage of malignant degeneration, which in my experience is high, may be, it is a menace that must be reckoned with, particularly as we have no means of foretelling which will and which will not ultimately develop carcinoma.

In conclusion, I have no hesitancy in repeating what I have on so many occasions emphasized, that the end-results are also dependent on the concomitant treatment of other foci of infection, particularly the appendix and the gall-bladder. Appendectomy is now a routine procedure in my clinic in connection with surgery for peptic ulcer, while cholecystectomy is done when the gall-bladder is diseased. Twelve per cent. of the cured cases had this additional operation performed.

Does not the surgeon of experience well know that by the time many, if not practically all, ulcer patients when they reach the operating table have a history of having been cured medically many times? Is not this delay in failure to recognize, that only by mechanical measures can the ulcer be gotten rid of, responsible for a number of the cases of engrafted carcinoma? It has been said the chronic ulcer patient is the property of the internist after having recovered from the operation. I will not take exception to this; I do take issue, however, with my colleagues who advise a trial of medical treatment for the chronic ulcer patient. My experience has taught me this is not only useless, but encourages delay which is too often dangerous. A chronic ulcer is always a chronic ulcer until removed.

Removal of the gall-bladder and the appendix at the time of the ulcer operation should be done, and is attended by little, if any, additional risk, providing the patient is in other respects normal, as determined by the various tests which you are all familiar with.

## THE CHOICE OF OPERATION FOR GASTRIC ULCER IN VIEW OF THE LATE RESULTS\*

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IN a consecutive series of fifty-seven cases of gastric ulcer, on which I have operated, the results, together with the symptoms and the pathology, have been studied with special reference to the choice of operation in various types of cases.

Seventy-five per cent. of these have been operated in the past six years, several of two types of operation date further back. Cases of acute or chronic perforation are not included.

There are five types of operation in this series: (1) Gastro-enterostomy; (2) excision; (3) mesogastric resection; (4) resection by the Billroth II method; (5) resection by the Polya method.

I. Simple gastrojejunostomy was practiced in nineteen cases, nearly 60 per cent. of which were done before the six-year period, above referred to, and none in the last three years. It is the simplest and safest of the five types of operation, but what as to its results? In four there was no return record, and, of the remaining fifteen, ten (66.6 per cent.) were well, two (13.3 per cent.) were improved, and three (20 per cent.) unimproved, at an average return date of thirty-four months after operation. Combining the well and the improved, the results were good in 80 per cent., a fairly creditable record.

When we come to study the cases we find that the ulcer was at the pylorus, or near it, in sixteen cases and in one its site was not specified. In seven of these there was marked cicatricial stenosis of the pylorus, with marked dilatation of the stomach in five. Vomiting was a prominent symptom in sixteen, and the presence of pyloric obstruction is shown by the fact that in five of these cases the vomitus contained material long before ingested. Also visible exaggerated peristalsis was noted several times.

It is in such cases of pyloric stenosis that simple gastrojejunostomy gives excellent results, and the results were good when the ulcer was near the pylorus, without producing marked stenosis. But in two cases the ulcer was near the middle of the stomach, on the posterior surface. One has no return record but the other has remained perfectly well, doing hard work, for over eight and a half years. Thus a cure may be effected even in such unfavorable cases, by gastro-enterostomy alone. At the present time, however, we would undoubtedly resect such ulcers if the patient's condition justified it.

The type of the lesion is indicated by the fact that in eight cases there was vomiting of blood, while in two others there was blood in the stools in six cases the stomach was adherent to the under surface of the liver and in four

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\* Read before the American Surgical Association, May 2, 1922.



## CHOICE OF OPERATION FOR GASTRIC ULCER

cases to the pancreas. The duration of symptoms averaged eight and one-quarter years, the average loss of weight, in the ten cases where this is noted in the history, was thirty-four and three-tenths pounds. Four were heavy drinkers, one had been previously operated for a perforating ulcer, without gastro-enterostomy, and the ulcer had recurred.

As to the technic of the operation two, dating back eighteen to twenty years, were done by the anterior method with the Murphy button, both giving excellent end results. In the remaining seventeen cases posterior gastro-enterostomy was done in all but three where, on account of marked posterior adhesions, a short loop retro-colic anterior gastro-enterostomy was done. This modification I first employed in 1910 and I have also used it in resections for ulcer and carcinoma with excellent results.

In five of the fourteen cases of posterior gastro-enterostomy the pylorus was excluded by the Wilms method in four and by infolding in one. But these gave no better results than without exclusion and this modification was discontinued.

Of the three cases classed as unimproved one was well for eight months when symptoms recurred. Later the pyloric end of the stomach was resected and he is now, five and a half years after the first operation, well as to gastric trouble. Another, well for three years, relapsed after drinking heavily and was resected. The ulcer found at the second operation was in the same region of the stomach, but on the opposite side, *i.e.*, an entirely new ulcer had formed. The third of these cases was not seen, but after being well for three and three-quarters months after operation, wrote three months later that she was hopelessly sick. One of the good results I saw two weeks ago, perfectly well fourteen and a half years after the operation. There was no mortality in this group.

II. The excision group is as small as any and four of its eight cases were done before 1916. The first one was done ten and a half years ago without gastro-enterostomy, but required it four months later on account of the early return of symptoms, which again recurred, and two years later a *v. Eiselsberg* exclusion was done. At these recurrences a duodenal ulcer, not present, or observed, at the first operation, was probably responsible for the symptoms. After the exclusion he was well for five and a half years, until attacked by persistent jaundice. An exploratory operation, done in Colorado, revealed a carcinoma which was thought by the operator to have had its origin in the pancreas or the stomach. If the stomach was the starting point of the growth this is the only case in this series where gastric cancer has occurred after an operation for ulcer. It can hardly be called a cancerous degeneration of a gastric ulcer, for the ulcer was excised and the later symptoms were due to the duodenal ulcer.

Three of this group gave no return record and one of these had no gastro-enterostomy. Of the remaining five, two (40 per cent.) are well, two (40 per cent.) are improved, and one, the first case mentioned, was well for five and

a half years after relapse and reoperation. This gives 80 per cent. of good results.

In one case there were multiple ulcers, three shallow ones with a moderate hour-glass constriction of the stomach, and one in the duodenum. All but two of the ulcers of this group were on the lesser curvature. Vomiting was present in half of the cases and in all of these blood had at some time been present in the vomitus. In one case the hæmoglobin was 36 per cent., or less, at the time of operation.

The superiority of fluoroscopic examination was demonstrated in one case by visualizing a small penetrating ulcer of the posterior surface which was not shown by the X-ray plates.

The rather unsatisfactory results of the earlier cases have probably deterred me from favoring excision as much as I might otherwise have done. In the last six years it has been restricted to ulcers far removed from the pylorus and always combined with gastro-enterostomy. Such operations are usually quite as difficult as a resection, when that is applicable. As a resection has given me better results in ulcers nearer the pylorus I have limited excisions to ulcers not suitable for resection on account of their distance from the pylorus. There was no mortality among these eight cases.

III. The mesogastric or sleeve resections form a group of nine cases. This operation was applied to those cases of ulcer at a distance of three to five inches (average nearly four inches) from the pylorus, when the antrum, distal to the ulcer, was relatively normal. It saves this part of the stomach which would be sacrificed by other forms of resection. For ulcers so situated it competes with excision. Of course if the substernal angle is narrow or the ulcer is too far from the pylorus, mesogastric resection is too difficult to be chosen. But the ulcers in this group were different from those in the excision group. They were larger and more indurated as a rule and, though two-thirds were at or near the lesser curvature, there were more adhesions, especially posteriorly. Five were adherent to the pancreas and in three the latter formed the base of the ulcer. Adhesions to the liver were present in three cases and an hour-glass contraction in one case. The glands were markedly enlarged in seven cases.

Gastrojejunostomy was not done at the primary operation in any case, thereby shortening the time of operation. The post-operative course was remarkably smooth in these cases, but the ultimate results were not so satisfactory. Three cases gave no return record and, of the remaining six, one is well, another is well after a secondary gastro-enterostomy. A third who had lues and obliterating endarteritis of the arteries around the ulcer was well for two and a third years when, after excesses in whiskey, symptoms recurred, and the result is unsatisfactory, as it was also in another case at an earlier date, making two unsatisfactory results. In the latter case an X-ray suggested an ulcer, or new growth, of the lesser curvature close to the line of resection, but the interpretation of X-ray plates, taken after these opera-

tions, is sometimes difficult. Reoperation was advised, but he refused, and was lost track of. Two other patients were much improved; 33.3 per cent. well and 33.3 per cent. improved is of course not satisfactory, but it should be remembered that these cases were among the worst types of gastric ulcer. All of them had vomiting, two-thirds vomiting of blood, the average loss of weight was twenty-five pounds (four cases), three were heavy drinkers, another was formerly, two had lues, one tuberculosis and one marked arteriosclerosis. Three had ulcerated through into the pancreas. In the literature several series of mesogastric resections are reported with more encouraging results. In spite of the poor late results in this group I still believe that mesogastric resection has a place in gastric surgery in a limited group of cases, but I should be inclined to do an excision and gastro-enterostomy in more of this type and restrict mesogastric resection. There was no mortality in this group.

IV. Resection by the Billroth II method was done in a small group of eight. Two of them had previously had a gastro-enterostomy with temporary relief and recurrence of symptoms. This type of operation is particularly applicable in such cases.

It is among the cases of this group that all of the deaths after operation for gastric ulcer occurred in my experience, except in cases of perforated ulcer. There were four deaths among these eight cases. Two were due to anæmia from previous severe hemorrhage. One lived twenty-five days, the other a week, and might perhaps have been saved if his brother had consented to give blood for a second transfusion, or another donor could have been secured. In both of these a gastro-enterostomy with a v. Eiselsberg exclusion was planned but could not be carried out on account of the induration of the distal or pyloric segment. A simple gastro-enterostomy would have been the better course, but this does not always control the hemorrhage. The two other cases died of pneumonia; one of them was alcoholic and most of his vital organs were diseased. I do not think that the type of resection had to do with the mortality in this group. It takes a little longer than the Polya method, which, as seen by the fluoroscope, gives a nearer approach to the normal stomach and better functional results. Of the four other cases two have no return record and two are well. The figures are too small to afford a basis for judging the results.

V. The Polya type of resection was done in thirteen cases, if we include one which proved to be a duodenal ulcer. Twelve were done by the Polya-Reichel technic, one by the Polya-Balfour. The very satisfactory convalescence and results in these cases was the factor which led me to compare the results in these five types of operation for gastric ulcer.

It is especially suitable for ulcers of the pylorus or antrum not too far removed from the former. Of the twelve gastric cases three were noted as at the pylorus, stenosing the latter, and seven in the pyloric portion. Nine were adherent posteriorly, to the pancreas in six and to the mesocolon in one. Vomiting was noted in ten and in eight it relieved the pain. Blood

was present in the vomitus in five. Loss of weight varied from ten to thirty pounds and averaged sixteen pounds. The age of the twelve gastric cases averaged forty-nine and a half years and ranged from twenty-five to seventy-five years, four of them being sixty-six or over.

In the Polya resections I have almost always first divided the stomach on the proximal side of the ulcer. The distal end is then turned to the right, which facilitates the division of any posterior adhesions. The reverse is done in mesogastric resections, on account of greater ease. The end result was a cure in ten (83.3 per cent.), improvement in two (16.6 per cent.) and there was no report in one. In other words, a good late result was obtained in 100 per cent. at an average time of thirty and a half months after operation. One of the two cases classed as improved was well for a year until he resumed alcohol, when he had slight stomach symptoms and lost seventeen of the thirty-seven pounds he had gained. For the next two years his condition was satisfactory until, after sustaining a fracture of the base of the skull, he had some return of slight gastric symptoms. If we class this case as unsatisfactory it leaves 91.6 per cent. of good results.

The Polya type of operation has the advantage of saving time by combining in one step the closure of the stomach and the gastro-enterostomy. If time is very important the Polya-Balfour technic has a slight advantage. The House Staff of the 2nd Surgical Division of Bellevue Hospital, where the majority of these operations were done, has often commented on the smoothness of the convalescence of the patients after Polya resections. Most of them I have seen fluoroscoped once or several times, from six months to some years after operation, and a striking feature is the normal character of the emptying of the stomach, moderately slowly and intermittently and not in the precipitate way of some cases after gastro-enterostomy. In fact, after a time, the distal end of the stomach, having contracted somewhat, looks and acts much like a large pylorus. The Polya type of operation has given me better results than any other operation for gastric ulcer. There has been no mortality in this group.

Jejunal or gastrojejunal ulcer has not developed in any of these cases of gastric ulcer which have return records.

Of course I am aware that the number of cases in these five groups is too small to give accurate percentage values, but not to indicate relative values, except perhaps as to excision with the cautery or knife, followed by gastro-enterostomy.

#### CONCLUSIONS

(1) For ulcers, three to four or more inches from the pylorus, the choice lies between excision and mesogastric resection. On account of the better results I prefer excision and gastro-enterostomy, except for ulcers with hour-glass contraction and large indurated ulcers, especially those on the posterior surface.

(2) For ulcers near the pylorus, or within three inches or so of it, I prefer

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the Polya method. It is easy, reasonably rapid and has given the best results of any method.

(3) In case the operation is done in two stages, or a gastro-enterostomy has previously been done, the Billroth II method is the rational procedure, but the two-stage procedure is rarely called for in cases of ulcer.

(4) For ulcers at, or close to, the pylorus, especially such as cause a stenosis, a posterior gastro-enterostomy is the simplest and safest operation, gives good results and may be the method of election for those not experienced in resection. It is quite possible for such an operation to benefit or cure ulcers remote from the pylorus.

(5) The possibility of cancerous degeneration of a gastric ulcer would in general lead to its resection or excision, but, as was long ago pointed out by Kocher and others, such degeneration is quite uncommon in cases treated by gastrojejunostomy. In view, however, of this danger, whether we class it at a high per cent. with some or a low per cent. with others, I firmly believe in the complete removal of gastric ulcers by resection or excision unless the operative risk is greatly increased on account of the general or local condition of the patient.

## A BACTERIOLOGIC STUDY OF THE FLUID CONTENTS OF 100 GALL-BLADDERS REMOVED AT OPERATION

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THERE is an idea, just how prevalent is not known, that the fluid contents of diseased gall-bladders often, if not always, contain bacteria. In view of this idea it has been considered wise to review the subject and to make observations.

The fluid contents of 100 unselected gall-bladders removed at operation were cultured. In making these tests there was no thought of asserting that the isolated organisms were those causing the disease of the walls, but simply to ascertain whether bacteria were present in the contained fluids possibly rather as secondary invaders whose existence had been rendered possible by changes in the contents of the gall-bladders attendant on changes in the walls. The term gall-bladder fluid rather than bile has been used advisedly, since in many cases there is very little bile present, the contents consisting largely of mucus, serum, blood, and degenerated epithelial and pus cells. Schöbl, in his work on "Experimental Cholera Carriers," observed at necropsy of guinea-pigs and rabbits, into whose gall-bladders he had injected cholera vibrios, that there were marked changes in the walls of the organs, and, that the fluid contents were very much altered; in some cases it was light yellow, in others a thin colorless liquid with a creamy sediment. The latter condition was observed in cases in which the cystic duct was occluded by inflammatory reaction. In none of the cases of this series in which bacteria were isolated did the fluid resemble pure bile; it consisted rather of mucus or fluid of a serous nature and in two cases there was no visible evidence of bile being present. The fluid was obtained, aseptically, as follows:

After searing an area of the outer surface of the wall of the organ, a sterile capillary pipette was introduced. Test tubes containing one per cent. glucose bouillon were inoculated with the withdrawn fluid serobically and anaërobically and incubated at 37° C., and plates of Teague's eosin-brilliant green agar were streaked with the same. This latter medium was used with the hope of isolating *Bacillus typhosus*; as this medium is supposed to inhibit the growth of all gram-positive, and all gram-negative organisms except *Bacillus typhosus* and an occasional strain of *Bacillus coli*. This has been found to be the case with laboratory cultures, but, to freshly isolated strains of *Bacillus coli* and a few other gram-negative organisms, such as *Bacillus pyocyaneus*, the medium is not inhibitory. However, to the trained eye the different aspect of these colonies is distinguishable from *Bacillus typhosus* and the diagnosis may be confirmed serologically and by planting in Russell's sugar-agar medium.

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TABLE I

*Infection in the Fluid of 100 Unselected Gall-bladders Removed at Operation*

Patients		Average age, years	Infected fluids	Non-infected fluids
Men.....	30	46.1	6	24
Women.....	70	40.0	13	57
Married.....	65	40.8	13	52
Single.....	5	29.8		5
Total.....	100		19	81

TABLE II

*Varieties of Bacteria Isolated from Nineteen Infected Fluids*

Patients	Bacillus coli	Staphylococcus aureus	Streptococcus hemolyticus	Sarcina, non-pigmented*	Total
Men.....	3	1	1	1	6
Women....	9	3	1		13
Total..	12	4	2	1	19

\* This organism will be regarded by some as a contaminator, but as sarcinae are sometimes present in the stomach<sup>1</sup> and intestine<sup>1,2</sup> it is possible that a strain may have found its way into the fluid contents of a diseased gall-bladder.

TABLE III

*Gross Pathologic Conditions in 100 Gall-bladders*

	19 Infected fluids			81 Non-infected fluids		
	Per cent.			Per cent.		
	Men	Women	Total	Men	Women	Total
Acute and chronic catarrhal cholecystitis.		5.2	5.2	2.4	2.4	4.8
Subacute cholecystitis.....	5.2		5.2	1.2	2.4	3.6
Subacute and chronic catarrhal cholecystitis.....	5.2	15.7	20.9	3.7	4.9	8.6
Chronic catarrhal cholecystitis.....	26.3	68.3	94.6	23.4	60.5	83.9
Chronic cystic cholecystitis.....					2.4	2.0
Pericholecystitis.....	5.2	5.2	10.4		1.2	1.2
Papillomatous cholecystitis.....		5.2	5.2	3.7	2.4	6.1
Strawberry gall-bladder with chronic catarrhal cholecystitis.....	5.2	10.4	15.6	9.8	24.6	34.4
Cholelithiasis.....	31.5	42.1	73.6	7.4	38.2	45.6
Empyema.....		10.4	10.4		1.2	1.2
Strawberry gall-bladder with cholelithiasis.....				2.4	12.4	14.8
Strawberry gall-bladder with papillomas.		5.2	5.2	1.2	3.7	4.9
Stone in cystic duct.....		5.2	5.2			

TABLE IV

*Findings in the Nineteen Infected Fluids*

	Cases	Cholelithiasis, per cent.	Papillomatous cholecystitis, per cent.	Strawberry gall-bladder with chronic catarrhal cholecystitis, per cent.
Bacillus coli.....	12	75	8.3	16.6
Staphylococcus.....	4	75		25.0
Streptococcus.....	2	50		
Sarcina.....	1	100		
Total.....	19			

From the foregoing facts it seems that a very small percentage of the fluid contents of diseased gall-bladders contain organisms capable of being grown on ordinary mediums. This failure in growth might be explained by the inhibitory action of bile on bacteria and a series of tests using various dilutions of bile inoculated with different organisms was studied in the following manner:

Eighteen organisms were inoculated into 10, 70, 80, 90, and 100 per cent. of ox-gall, the dilutions being made with 1 per cent. glucose-bouillon. Controls in 1 per cent. glucose-bouillon were also made. The results are shown in Table V.

TABLE V  
*Effect of Bile as a Medium on the Growth of Organisms*

Organism	Strains cultured	Glucose-bouillon, 1 per cent.	Ox-gall				
			10 per cent.	70 per cent.	80 per cent.	90 per cent.	100 per cent.
Staphylococcus albus...	1	+	+	+	?	—	—
Staphylococcus aureus..	3	+	+	+	?	?	—
Streptococcus hemolyticus.....	2	+	+	+	?	?	—
Non-pigmented sarcina.	1	+	+	—	—	—	—
Sarcina lutea.....	1	+	+	+	+	?	—
Bacillus pyocyaneus...	2	+	+	+	+	+	—
Friedlander's bacillus...	2	+	+	+	?	?	—
Bacillus coli communis..	17	+	+	+	?	—	—
Bacillus coli communior.	1	+	+	+	?	—	—
Bacillus typhosus.....	3	+	+	+	?	—	—
Bacillus paratyphosus A.....	1	+	+	+	+	—	—
Bacillus paratyphosus B.....	1	+	+	+	+	?	—
Flexner's bacillus.....	1	+	+	+	?	—	—
Shiga's bacillus.....	1	+	+	+	—	—	—
Bacillus alkaligenes....	1	+	+	+	?	—	—
Bacillus aerogenes.....	1	+	+	+	+	—	—
Bacillus enteritidis.....	1	+	+	+	+	—	—
Bacillus proteus vulgaris.....	1	+	+	+	?	—	—
Total, per cent....		100	100	+94.2 — 5.8	+33.3 ? 55.5 —11.1	+ 5.5 ? 27.7 —66.6	100

These organisms, with the exception of the non-pigment-forming sarcina, all grew well in the control solution and in 10 and 70 per cent. ox-gall, while in 80 per cent. ox-gall only 33.3 per cent. of the organisms grew; in 90 per cent. ox-gall only 5.5 per cent. grew, and there was no growth in the pure ox-gall. This last fact caused no surprise as, a few years previously, it had been found impossible to keep three strains of cholera vibrio alive in pure bile, while there was no difficulty in doing so in a 50 per cent. dilution with plain bouillon. The results obtained from these tests, repeated many times, tend only to increase the belief in the hypothesis that organisms will not grow in pure bile, and that in order to produce a culture the medium must not contain more than 70 per cent. of bile.



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It may be contended that pure ox-gall is used for the isolation of *Bacillus coli* and *Bacillus typhosus* from blood, water, and milk, and exception may be taken to the foregoing results; but this objection is overruled by the fact that in none of these cases is pure bile really the medium as the amounts of blood, water, and milk inoculated are such as to dilute the bile sufficiently to allow of growth. It is a significant fact, the larger the amount of suspicious fluid introduced into this pure bile medium, the greater the chances of obtaining a positive culture, and it may be rightly contended that this is owing not so much to the greater likelihood of introduction of organisms, as to the fact that there is a higher dilution of the bile medium. For example, 10 c.c. of pure bile inoculated with 5 c.c. of blood, water, or milk will give a bile content of only 66 per cent. and 10 cm. with 1 c.c. one of 90.1 per cent.; it is a well-known fact that very often no growth of bacteria takes place after such a small amount of suspicious fluid is introduced. A comparative series of tests was made with fluids from ten gall-bladders removed from patients at operation; the fluid had been proved sterile by incubating and culturing. *Bacillus coli* was utilized as the inoculating organism and control cultures were made with a 1 per cent. solution of glucose-bouillon (Table VI).

TABLE VI  
*Effect on the Growth of Bacillus Coli of Gall-bladder Fluid from Ten Patients*

	Concentration			
	70 per cent.	80 per cent.	90 per cent.	100 per cent.
Fluid 1.....	+	—	—	—
Fluid 2.....	+	—	—	—
Fluid 3.....	+	—	—	—
Fluid 4.....	—	—	—	—
Fluid 5.....	—	—	—	—
Fluid 6.....	—	—	—	—
Fluid 7.....	—	—	—	—
Fluid 8.....	—	—	—	—
Fluid 9.....	?	—	—	—
Fluid 10.....	+	+	+	+
Total results, per cent.....	+40 ? 10 —50	+10 —90	+10 —90	+10 —90

Control cultures with one per cent. glucose-bouillon were positive in every instance.

The tests with the first three fluids seem to show that increased concentration of fluid reduces the possibility of the successful growth of the organism. From this it may be inferred that fluids 4, 5, 6, 7, and 8 were probably of higher concentration than fluids 1 to 3; and that fluid 9 was of moderate concentration; the concentration of fluid 10 must have been low, as there was growth in all dilutions.

In order to rule out the possibility that these results were due to the presence or absence in these fluids of immune bodies for these bacteria, another series of tests was made. Fluids from four gall-bladders, removed at operation, were pooled and proved sterile. This fluid was not heated or treated in any way that might destroy any contained immune substances.

Dilutions were made and inoculated with *Staphylococcus aureus*, *Bacillus coli*, *Bacillus typhosus*, and *Bacillus pyocyaneus*; controls were made in 1 per cent. glucose-bouillon. In Table VII are recorded results which seem to corroborate the conception that immune bodies in the gall-bladder fluid, if present, do not inhibit growth in the experiments herewith reported.

TABLE VII  
*Effect of Possible Immune Bodies in Bile on the Growth of Organisms*

	Pooled, sterile fluid from four gall-bladders				
	Glucose-bouillon, 1 per cent.	10 per cent.	50 per cent.	70 per cent.	100 per cent.
<i>Staphylococcus aureus</i> I.....	+	+	+	+	—
<i>Bacillus coli</i> V.....	+	+	+	+	—
<i>Bacillus typhosus</i> II.....	+	+	+	+	—
<i>Bacillus pyocyaneus</i> II.....	+	+	+	+	+
Total, per cent.....	100	100	100	100	—75 +25

The growth of *Bacillus pyocyaneus* in a 100 per cent. concentration of this mixed fluid points to the fact that either this was in reality not of such high concentration or that *Bacillus pyocyaneus*, being a very resistant organism, can grow in mediums where other organisms cannot. It might be contended that this lack of growth in the greater concentrations was owing to the presence of immune bodies which are absent in the higher dilutions.

Table VIII shows similar results obtained when sterile ox-gall was substituted for the mixed human fluid from the gall-bladders of ten patients.

TABLE VIII  
*Effect of Substituting Sterile Ox-gall for Mixed Fluid of Foregoing Experiment*

	Glucose-bouillon, 1 per cent.	Sterile ox-gall			
		10 per cent.	50 per cent.	70 per cent.	100 per cent.
<i>Staphylococcus aureus</i> I.....	+	+	+	+	—
<i>Bacillus coli</i> V.....	+	+	+	+	—
<i>Bacillus typhosus</i> II.....	+	+	+	+	—
<i>Bacillus pyocyaneus</i> II.....	+	+	+	+	?
Total, per cent.....	100	100	100	100	—75 ? 25

From these experiments it seems to be quite permissible to assume that the growth of bacteria will not take place in pure bile and the reason that infected gall-bladder fluid is found in such a small percentage of cases (nineteen) is because the concentration of bile is too high to permit of the growth of bacteria. Rous and McMaster, in 1921, advanced the theory that concentration of bile is one of the functions of the gall-bladder.

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### CONCLUSIONS

1. In a series of 100 gall-bladders removed at operation only 19 per cent. contained fluid infected with bacteria; the infecting organisms were *Bacillus coli* in 12 per cent. of the cases, a staphylococcus in 4 per cent., a streptococcus in 2 per cent., and a non-pigment-forming sarcina in 1 per cent.

2. The probable reason there is not a higher percentage of infected gall-bladder fluids is that the contained fluids have a concentration of bile too high, for bacteria will not grow satisfactorily if more than 70 per cent. of bile is present.

3. In the 19 per cent. of infected gall-bladder fluids the concentration of the normal bile had been lowered by inflammatory exudates, thus permitting the growth of bacteria in the fluid contents of the gall-bladders.

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## TRAUMATIC PANCREATITIS

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THE pancreas is rarely injured. Even in penetrating gunshot wounds of the abdomen the percentage of pancreatic injuries is exceedingly low, much lower, in comparison to injuries to other organs, than the size of the pancreas would lead one to think.

Many pancreatic injuries are never recognized because death follows quickly and no autopsy is performed. Wallace reports (*Lancet*, 1917) only five injuries to the pancreas in 965 penetrating gunshot wounds of the abdomen, while Frazer and Drummond (*British Medical Journal*, March, 1917) found only one pancreatic injury in 300 gunshot injuries of the abdomen.

In the case where a cyst arises subsequent to the pancreatic injury, the following conditions probably obtain:

The pancreas is torn or mashed in such fashion that some of the ducts are divided, with escape of pancreatic juice. Hemorrhage, of lesser or greater degree, occurs at the same time. If the peritoneal coat over the pancreas is torn, as is usually the case, then there will be fat necrosis involving the omentum. An adhesive peritonitis follows, sealing in the injured spot or spots of the gland.

The pancreatic fluid continues to form, pushing its way between the peritoneal layers. Thus the cyst grows drop by drop, the endothelial lining of the wall contributing its share of fluid to dilute the pancreatic secretion. The color of the fluid varies as the amount of blood contained.

After a time when the intra-cyst tension has become very great, the torn ducts become sealed-off by contracting scar tissue, and at the same time the corresponding parenchyma cease to function and atrophy. The endothelium of the cyst wall may continue to secrete its fluid long afterward, the cyst thus growing larger and larger. Such a case came under my observation last year.

*Case History.*—D. L. S., a small negro boy, aged four, was admitted to the Hillman Hospital, April 26, 1921, with the history of having been injured two weeks prior. His parents averred that the rear wheel of a wagon had run over the child's abdomen. The child was somewhat shocked and complained of pain in the upper abdomen at the time of injury. At the time of admission there was a suggestion of fullness in the epigastrium, with slight tenderness over the same area. Temperature was normal, pulse normal, white blood-cells 13,000, urine normal, except for a trace of albumen.

The parents were opposed to operation and took the child home after thirty-six hours in the hospital. He remained at home, being seen from time to time by a competent practitioner. About May 28th, or six and a half weeks after the injury, the patient was returned to the hospital by his physician. At this time there was a distinct globular swelling in the epigastrium about the size of an orange. It was tense, somewhat tender and almost completely fixed. Stereo-X-ray pictures showed a spherical cloudiness in the upper abdomen. Temperature normal, pulse normal, respiration normal, white blood-cells 10,000, urine negative. The history and findings, the shape and position of the tumor led us to make a diagnosis of pancreatic cyst.

Operation June 1, 1921; median incision above umbilicus. The omentum presented numerous yellowish-white spots of fat necrosis. A large globular cyst was immediately exposed, lying behind the stomach in the lesser sac. By tearing through the mesocolon the cyst was fully exposed, packed off and drained with trocar and canula, about three pints of limpid fluid escaping. The interior of the cyst was fully exposed and at the deepest part there was to be seen a small elliptical opening about the size of one's little finger-end. This opening communicated with the body of the pancreas at a point just to the left of the median line of the body. The edges of the cyst where the trocar had entered were sutured to the parietal peritoneum in the anterior abdominal wound, a large tube drain inserted deeply into the cyst cavity and the abdomen closed without other drainage. The laboratory reported that the fluid contained pancreatic ferments and that the omental tissue showed fat necrosis. Convalescence was uninterrupted. The secretion was never very profuse and gradually grew less. Daily irrigations of 1-10,000 silver nitrate were made into the cyst cavity. The secretion rapidly grew less and the patient gained in strength and weight. He left the hospital entirely healed, seventeen days after the operation. Since that time he has remained entirely well.

Stuart reported a case (*Northwest Medicine*, March, 1921) and collected fifty-three similar cases in the literature, in which the injury was subcutaneous. Of these the results were known in forty-six cases. There were thirty-nine operated upon, twelve died, twenty-seven recovered.

Ochsner reports a case (*ANNALS OF SURGERY*, October, 1921) of abscess of the pancreas successfully drained from behind. He first made an exploratory laparotomy.

The question of drainage of these cysts has been the subject of several papers in the recent literature, with a tendency to favor drainage from behind. Delatour, of Brooklyn, reports a case (*ANNALS OF SURGERY*, October, 1921) treated in this manner at the end of an exploratory laparotomy. The patient was cured.

I doubt if it is ever safe to approach such a swelling from behind, without

first exploring the contents of the abdomen under the naked eye. Posterior drainage, the force of gravity considered, appeals to one as most rational. In the case of pancreatic abscess, it should certainly be the operation of choice. Anterior marsupialization has given such satisfactory results in the great majority of cases reported in the literature that it should ordinarily be the operation of choice. Complete excision of the cyst may perhaps occasionally be accomplished with ease, but in the great majority of cases it will be found impractical and impossible.

## FAULTY ROTATION OF THE INTESTINE\*

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THE development of the intestinal tract in man and the lower animals has received a great deal of attention from anatomists and embryologists and the various stages of the processes involved are now well known and described. The intestinal tract of man in its development passes through phases which are permanent in some of the lower vertebrates, and a study of the splendid monograph of Huntington,<sup>1</sup> which is based on a very extensive investigation and knowledge of human and comparative anatomy, affords a mine of information concerning structural details and the ontogeny and phylogeny of the parts, as well as giving an explanation of many of the abnormalities which are observed in operations and at post-mortems.

It is not the purpose of the writer to attempt to describe the development of the alimentary canal, indeed it would obviously be quite unnecessary; some of the abnormalities will be alluded to, the clinical manifestations briefly discussed and a few personal experiences mentioned. These abnormalities are sufficiently common to merit consideration by the practical surgeon and numerous more or less systematic articles and many case reports are to be found in the literature.

Just why certain foetal conditions sometimes persist after birth is not certainly known; indeed, the cause of the rotation of the intestine around the superior mesenteric vessels is not positively determined. This rotation takes place to a varying degree in mammals, but not in lower vertebrates, and would seem to be in some way connected with the growth of the colon; probably several mechanical factors are concerned. Frazer and Robbins<sup>2</sup> suggest that rotation is due to the narrow aperture of the sac of the "embryonal umbilical hernia"; the cæcum, on account of its large size, returns later to the abdominal cavity than the small intestines and has to find room and adjust itself to the position of the small intestines which have previously returned. According to this view then, non-rotation might be accounted for by an earlier entrance of the cæcum into the abdominal cavity, due to its smaller size, or perhaps to a larger opening between the umbilical vesicle and the abdominal cavity.

When the colon fails to rotate the mesentery does not become fixed as a rule, and then it is possible for volvulus to occur, thus giving rise to intestinal obstruction. Intra-uterine peritonitis resulting in the formation of adhesions may account for failure of rotation as some have suggested.

The abnormalities to be mentioned will be considered under two heads:

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\* Read before the American Surgical Association, May 2, 1922.

1st, Faulty rotation. 2nd, Defective fixation of certain portions of the intestine. Both frequently are associated. No attempt is made here to mention all the anomalies that may be encountered.

*a.* Faulty rotation of the stomach, so that the pylorus is turned to the left; these may be associated with absence of fixation of the duodenum, which then has a free mesentery and volvulus may occur; such cases are quite rare.

*b.* Failure of the large intestine to rotate, resulting in the so-called "left-sided colon," the small intestine is on the right side of the large. In these cases the large and small intestine from the duodeno-jejunal junction to the end of the sigmoid may have a common mesentery, which is only two or three inches in width, and from this narrow mesentery nearly the entire intestinal tract is suspended. In instances of "mesenterium commune" the cæcum may be on the right side, as one of the cases to be referred to later will show, and there is a great likelihood of a volvulus to occur, the narrow neck of the mesentery becoming rotated. In other cases there has been fixation of the mesentery. In this group of course are to be placed the cases of left-sided appendix which are now and then found.

*c.* Failure of the cæcum to rotate, so that the ileum enters it from right to left, instead of from left to right, and some coils of small intestine are apt to be found behind the ascending colon. I have repeatedly encountered instances of this sort in searching for the appendix.

*d.* Failure of the cæcum to descend, so that it occupies a position just below the liver. The chief interest in this anomaly of course arises in cases of inflammation of the appendix, when the differential diagnosis becomes difficult or impossible, owing to the unusual position of the organ. When the colon fails to rotate, the superior mesenteric artery lies behind or dorsal to the duodenum, and the vasa intestini-tenues come from the right side of the artery and the colic branches from the left; these abnormalities of the vessels have little or no surgical significance however.

*e.* Faulty fixation of the intestine: This is usually associated with defective rotation; there is absence of fixation of the large intestine or the fixation occurs in an abnormal situation. One of the more frequent forms of faulty fixation consists of the well-known mobile cæcum, which has a mesentery of varying length, and this predisposes it to various conditions which will be referred to later. Another common manifestation of faulty fixation consists in the attachment of the appendix posterior to the ascending colon and pointing upward.

Though not connected directly with rotation of the intestine, I should like briefly to refer to a developmental anomaly about the gall-bladder. This consists of the presence of the cystico-duodenal or cystico-colic fold, which extends from the gall-bladder to the duodenum or colon, in the shape of a double fold of peritoneum, and in its appearance is suggestive of a pathological adhesion. This ligament is really the right border of the gastro-hepatic omentum which extends further to the right than normal; it is fairly often seen.



The presence of this fold may perhaps, by causing kinking of the neck of the gall-bladder and cystic duct, produce symptoms somewhat simulating gall-stones or cholecystitis. In a case in which gall-stones were suspected, because of moderately severe attacks of pain in the right hypochondrium, I found no stones or evidences of cholecystitis, but a very distinct cystico-duodenal ligament; this was divided and there have been for two years no attacks of pain. In two cases occurring recently, a diagnosis of duodenal ulcer was made by a röntgenologist from a deformed duodenal cap; at operation I found no ulcer, but there was in each instance a cystico-duodenal ligament, thus suggesting that this ligament may cause a deformity of the duodenal cap.

In these cases of faulty rotation of the intestinal tract, volvulus of a large part of the gut may occur, particularly in the instances of mesenterium commune, where the greater part of the colon and the whole of the small intestine except the duodenum are suspended by a narrow mesentery; also when the cæcum and the lower part of the ileum have a common mesentery. It is also likely that in such cases less severe and more temporary manifestations, in the shape of recurring attacks of cramp-like pains, sometimes associated with vomiting, can and do occur; in two of my cases there was a distinct history of repeated colicky attacks, extending over a period of years. Probably some instances of attacks of abdominal pain and of vomiting, which the clinician cannot account for, and which pass off spontaneously, can be explained by the developmental errors mentioned.

The possibilities of disturbance in the cases of mobile cæcum are numerous and there is not as yet agreement as to all of the clinical manifestations of this condition. The operation of cæcopexy to remedy this condition for a time was in vogue, but seems to be less frequently done of late. Appendicitis may be simulated by volvulus of the cæcum.

Irregularities and variations in mesenteric adhesion are also responsible in part at least for the formation of various fossæ, such as the duodeno-jejunal and intersigmoid, and these, as is well known, are occasionally the seat of internal or retroperitoneal herniæ.

In the diagnosis of some of these cases of errors of rotation, assistance has been obtained by X-ray examination.

The following cases will illustrate the leading features of volvulus of the whole or part of the intestinal tract, when due to errors of rotation or fixation.

CASE I.—Volvulus, of nearly the entire intestine, in a case of mesenterium commune: Male, age twenty-three years, operated upon for acute appendicitis. At the operation the cæcum was found in the right iliac fossa and nothing in particular was noted in regard to it except that it was freely movable; an acutely inflamed appendix was removed. On the fifth day after operation the patient had a great deal of nausea, vomiting and abdominal pain; some relief was afforded by gastric lavage. The vomiting, however, continued on the following days; the

epigastrium was distended, there was a succussion splash in the stomach, the lower abdomen was scaphoid, no bowel movements could be obtained and there was no fever. The condition was diagnosed as dilatation of the stomach and large quantities of fluid were evacuated by the stomach tube from time to time. He became progressively worse and died on the ninth day. We were told that the patient had had a number of attacks of abdominal pain and vomiting, dating back to childhood. The autopsy revealed the following facts: The stomach and duodenum were greatly distended; from the duodeno-jejunal junction downward the whole small and large intestine were practically empty, the small intestine being behind the large. Rotation of a narrow and long common mesentery had taken place from right to left, around the superior mesenteric artery for a distance of about  $180^{\circ}$ . The small intestine was much congested and the mesenteric veins were engorged. The cæcum which at the time of the operation had been on the right side, was now on the left.

In the above case, therefore, we have an instance of a persistent common mesentery of the large and small intestine, the cæcum had reached the right iliac fossa but had not become fixed; after the operation there occurred a volvulus from right to left around the narrow mesentery resulting in obstruction at the lower end of the duodenum. The epigastric distention and vomiting, and the absence of distention of the lower abdomen, which were observed during life were thus accounted for.

Volvulus of a loop of the ascending colon, the cæcum being fixed in the right iliac fossa, has been observed by Treves and Curschmann; this is exceedingly rare.

The appendix and apex of the cæcum may point toward the liver, the ascending colon being sharply bent, and instances of fatal obstruction from this cause are recorded. A loop of the transverse colon may lie between the liver and the anterior abdominal wall, thus giving rise to a resonant note on percussion at the usual site of hepatic dullness, and resulting in various difficulties in diagnosis.

When the cæcum and lower ileum have a common mesentery, and the cæcum has failed to become fixed, volvulus of these parts may occur. Two instances have fallen under my observation.

CASE II.—A young male, adult, suddenly seized with severe pain in the right lower abdomen; when seen twenty-four hours later, there were tenderness and distention in the right iliac region; normal temperature and a leucocytosis of 17,000. A diagnosis of appendicitis was made. At the operation the much distended cæcum was found to have a long mesentery, upon which it was rotated for about  $90^{\circ}$ ; when untwisted some gas passed on into the ascending colon and the rest was evacuated by removing the normal appendix. Recovery took place.

CASE III.—A young male, adult, who presented all the signs of an acute mechanical obstruction of the bowels; of three days' duration.

## FAULTY ROTATION OF THE INTESTINE

At the operation there was found an enormously distended and almost gangrenous cæcum which was twisted on its long mesentery; it could not be delivered from the abdominal cavity; it was opened and a tube put in. The patient died on the sixth day of his illness. Inquiries made after the condition was recognized brought out the fact that the patient had had repeated attacks of abdominal pain of varying severity and duration. At the autopsy the cæcum was found to have a long mesentery upon which the gut had become rotated, resulting in obstruction and strangulation.

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## PROLAPSE OF THE RECTUM IN CHILDREN\*

THE D'ESPINE METHOD OF TREATMENT

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SURGEONS who have been connected with a children's hospital or dispensary know the difficulties encountered in dealing with prolapse of the rectum in children. A recent report by Findlay, of Glasgow (*Brit. Journ. Children's Dis.*, 1921, vol. xviii, p. 83), of the successful treatment of this disorder by injections with alcohol and the simplicity and ease of the method as well as the splendid results, stimulated me to give the method a trial, with results so satisfactory that I feel justified in making this contribution to the subject.

Findlay first observed the procedure in D'Espine's Clinic at Geneva in 1919. He subsequently treated twenty-two cases, the children ranging from five months to five and one-half years of age, in some of them the prolapse having been present for a number of years. A complete cure was obtained in every instance.

Submucous injection for the relief of prolapse of the rectum is not a new procedure. Langenbeck several years ago recommended injections of ergot, alcohol and glycerine, while other surgeons have advised strychnine, ergot and strychnine, white oak bark, carbolic acid, etc. The use of the last two, especially carbolic acid, has been entirely discarded on account of the danger of infection.

The submucous injection method as a treatment for prolapse of the rectum does not seem to have met with favor, since very little mention is made of it in text-books, probably on account of the danger of infection or its failure to produce a cure. Neither of these objections seem to apply to D'Espine's alcohol injections. Findlay makes no mention of infection or other untoward effects in any cases so treated.

It is true that prolapse of the rectum in children can often be cured by carefully studying the patient, regulating the diet, removing the irritating causes if any exist, controlling the diarrhœa, or in some instances constipation, strapping the buttocks, and the administration of cod-liver oil or some other tonics. Some cases, however, do not yield to these conservative measures and demand more radical methods, such as cauterization or operation. While cauterization is very successful in prolapse of the anus and in partial prolapse of the rectum, the results in complete prolapse of the rectum are sometimes disappointing. The cure of complete prolapse of the rectum in children, and especially in adults, is, to say the least, difficult. Many opera-

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tions have been devised with more or less, generally less, successful results. Some of them chiefly applicable to the condition as occurring in adults are as follows:

Hey, in 1788, with the idea of narrowing the anal canal, removed a small triangular piece of the orifice and sutured the gap.

Thiersch passed a silver wire subcutaneously around the anus.

Gurnsey sought to form a cylindric canal at the anal orifice by injecting wax at the rectal outlet.

Lange proposed infolding the wall of the ampulla, and Mummery packed the ischio-rectal fossa with gauze. Other surgeons have resorted to hitching operations, such as rectopexy (Verneuil), colopexy (Jeannel), sigmoidopexy (Allingham).

Resection also has been advocated and tried. Mikulicz, for example, resected the prolapsed bowel; von Eiselsberg resected the sigmoid flexure and anastomosed it with the drawn-up rectum. All these operative procedures are formidable ones and scarcely to be supported by a young child already weakened by a more or less protracted enervating illness. Recurrence after most of these operations is not uncommon and the mortality in some is naturally high.

As to the cause of prolapse of the rectum. The most frequent exciting cause seems to be concerned with abnormal intra-abdominal pressure, with muscular weakness as the predisposing factor. Anatomically the rectum owes its support to the curve of the sacrum, the antero-posterior and lateral curves of the rectum itself, the meso-rectum, the peritoneum, levator ani and the sphincter muscles. The shape of the rectum, its valves, the ampulla and the peri-rectal fat and fascia, each in turn also plays its part. The fact that children are so much more frequently affected than adults seems to be due to the lax meso-rectum, the shallowness of the sacrum, as well as to the shape of the rectum and to weak muscular structure.

Some of the cases in the series of personal observations included in this report were studied for nerve changes, and by the X-ray for spina bifida, and abnormalities of the rectum and colon. The results were negative, except that all cases presented a weak and flabby musculature, the condition being generalized, but more marked in the muscles of the lower extremities.

Certain authorities believe that prolapse of the rectum usually begins with prolapse of the anus, but this hypothesis is not accepted by all. Others hold that prolapse of the anus is one of three types of prolapse in the rectal region, the other two being partial and complete prolapse of the rectum.

Partial prolapse is probably the most common form. Waldeyer has demonstrated that prolapse of the rectum usually begins, not by dragging from below, but from downward visceral pressure in the peritoneal cul-de-sac, while the exciting cause of anal prolapse may be polypus or hemorrhoids.

The technic of D'Espine's method, as described by Findlay, is as follows: The operation is performed under general anæsthesia, the patient having been

prepared in the usual way by purgation or by enema for completely clearing out the bowel. The perineum is cleaned with methylated ether and disinfected with iodine. The finger is placed in the rectum so as to gauge the position of the needle, and 1.5 c.c. of absolute alcohol is injected on each side of the rectum at about a depth of 7 cm. The needle (an ordinary exploratory needle with the syringe containing the required amount of alcohol attached) is inserted about 8 mm. (one-quarter inch) from the anal margin and is passed along the side of the bowel just outside of the mucous coat for about 6 to 8 cm. (two and a half to three inches) where the alcohol is injected. This is done, as already said, on both sides. The punctures are then sealed with collodion, and after applying a fairly large pad, the

TABLE I

Name	Sex	Age	Duration of prolapse	Cause of prolapse	Date of injection	Amount injected	Result
M. C. . . .	M.	5 years	8 weeks	Ileo-colitis	8/23/21	2 lat. inj. 1.5 cc.	Cured
A. H. . . .	F.	2 years	3 weeks	Diarrhoea	10/26/21	2 lat. inj. 1.5 cc.	Cured
A. B. . . .	F.	33 mos.	3 weeks	Pertussis	10/26/21	2 lat. inj. 1.5 cc.	Cured
A. McK.	F.	5 years	1 year	Colitis	10/26/21	2 lat. inj. 1.5 cc. 2 injections, 4 points injected. Reoperation 6 weeks later. 1.5 cc.	Cured
C. K. . . .	M.	2½ years	Unknown	Unknown	12/3/21	2 lat. inj. 1.5 cc.	Cured
J. K. . . .	M.	5 years	Unknown	Unknown	12/3/21	2 lat. inj. 1.5 cc.	Cured
J. K. . . .	M.	22 mos.	2 weeks	Diarrhoea	12/3/21	4 points injected, 1.5 cc.	Cured
G. B. . . .	M.	4 years	3 years	Ileo-colitis	12/3/21	3 points injected, 1.5 cc.	Cured
A. R. . . .	F.	13 mos.	12 mos.	Colitis	12/7/21	4 points injected, 1.5 cc.	Cured
E. H. . . .	M.	4 years	1 year	Diarrhoea	1/12/22	2 points injected, 1.5 cc.	Cured
F. R. . . .	F.	3 years	3 mos.	Diarrhoea	1/16/22	2 points injected, 1.5 cc.	Cured

buttocks are strapped. The child must be kept in bed for eight to ten days and the bowels kept constipated. The patient must not be allowed to sit up to defecate; the bowel movements are passed along the side of the dressing with the child lying in bed. The dressings are renewed daily, or as often as necessary, for eight to ten days, when they usually can with safety be discarded and the child then allowed to get out of bed.

I have used this method in eleven consecutive cases, two of them very severe ones, and have obtained a cure in each instance, without any post-operative complications, such as infection, loss of sphincter control, etc.

As will be seen in the accompanying table only one case required reoperation; this was done six weeks after the first injection, and in this case four punctures were made instead of two. The failure of the first injections in this patient was due, I believe, to the administration of a cathartic by mistake on the third day following operation.

I have thought it of interest to give the following case history in order to

illustrate the severe type of prolapse that can be relieved by this simple method. It was this case that convinced me of the value of this procedure.

A. R., female, aged thirteen months, weight eleven pounds, three ounces, was brought to the Children's Hospital of the Mary J. Drexel Home of Philadelphia, October 3, 1921, for relief of prolapse of the rectum, which had been noticed when the child was three weeks old and had been gradually increasing until admission. The prolapse was down from 8 to 10 cm., and was ulcerated and oedematous. Accompanying symptoms were tenesmus, frequent watery mucous stools and general weakness. The child was bottle-fed since the third week of life.

Examination shows: Athreptic girl baby, thirteen months old, head square and chest moderately rachitic. Abdomen—liver palpable about 4 cm. below costal margin. Rectal—rectum prolapsed about 10 cm., the mucous membrane being inflamed and ulcerated at five or six points. Physical examination otherwise negative. The rectum could not be replaced without an anæsthetic on account of straining. When replaced under anæsthesia the prolapse immediately recurred. After many unsuccessful attempts to keep the rectum in place by means of strapping the buttocks, the prolapse was finally allowed to remain down and kept clean with boric acid ointment and every effort was then directed toward improving the child's general condition, which was so poor that operation could not be attempted.

On December 7th, two months after admission, the baby having gained two pounds, two ounces, in weight and the general condition having greatly improved, I decided to attempt reduction and fixation of the rectum by means of absolute alcohol, according to D'Espine's technic. The baby was first purged and then constipated by means of boiled milk, paregoric and bismuth subcarbonate.

The second day after operation the baby had three small constipated bowel movements but the rectum did not come down, nor was there any prolapse after that, in spite of the administration, at various times, of castor oil, calomel and cascara. X-ray studies of the intestinal tract and spine revealed no abnormalities.

From January 10 to 21, 1922, the infant weathered a severe attack of bronchopneumonia. It was finally discharged January 31, 1922, weighing sixteen pounds, eight ounces, without any sign of prolapse of the rectum; general condition good.

Findlay believes there are two factors responsible for the cure by this method of treatment. He believes that at the seat of injection there results a certain amount of irritation with the formation of fibrous tissue and a probable fixing of the bowel wall to the tissues of the pelvic cavity. He examined per rectum many of the cases at varying periods after the injections, but could detect no evidence of thickening, induration or stenosis of the bowel.

We have made similar examinations in the cases of this series without finding any stenosis, thickening or induration.

The other factor which Findlay calls attention to as playing a part in the cure is the early return of the tone of the sphincter muscle; in his experience the sphincter had quite regained its tone within ten days following the alcohol injection.

## TREATMENT OF CANCER OF THE RECTUM\*

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THERE are but three agencies recognized in the treatment of cancer. These are cautery, radiotherapy and surgery. For obvious reasons, the cautery may be eliminated in the treatment of cancer of the rectum, except in the lower two inches, and even there it has no advantages. This leaves but two agencies with recognized standing for the treatment of cancer of the rectum. These are radiotherapy and surgery. Owing to its anatomical location, the application of X-ray is impractical, which reduces radiotherapy to the use of radium.



FIG. 1.—The sigmoid is mobilized by cutting the peritoneum on each side of its mesentery. Dotted line indicates incision of peritoneum of cul-de-sac around rectum and between bladder and rectum.

The remarkable success of radium in treatment of cancer of the uterus has led us to hope that the same might be true of cancer of the rectum. We have been greatly disappointed. A satisfactory reason for our failure to get good results in cancer of the rectum has not been given.

Hochenegg's clinic reports

more than seven hundred cancers of the rectum treated. Of these twenty-eight were treated by radium and only one gave good results. Many were made very uncomfortable and were worse than if no treatment had been given. Some other clinics have had equally disappointing results.

During the past three years I have used radium in eight cases of cancer of the rectum. In order to give the radium the greatest opportunity for cure, a preliminary colostomy was performed and the radium was drawn immediately into the growth as accurately as it could be done in carcinoma of the

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## TREATMENT OF CANCER OF THE RECTUM

cervix. In some of the cases a rectal tube was passed down through the colostomy opening and out through the rectum. Radium tubes were arranged in tandem in the rubber tube. An annular pack of gauze was sewed around



FIG. 2.—Superior hemorrhoidal artery is ligated and cut. Also vessels of the mesosigmoid.



FIG. 3.—Clamping and cutting sigmoid after vessels have been ligated. Note one of the clamps passes through the stab wound of left rectus muscle.

the tube just partially covering the lower tube of radium. This circular pack of gauze was for the purpose of stopping the tube in the growth as it was drawn upwards. Gauze was then packed in the rectum below this and a safety pin passed through the end of the tube as it emerged from the colostomy opening. In cases where the growth was strictly limited to one wall of the rectum, a sheet of lead was placed on the opposite wall for its protection. In one case of very extensive cancer of the lower rectum, the growth apparently was temporarily killed. An annular scar took its place. Owing to the advanced condition of the disease, the patient died within a few months with extension farther up in the pelvis. No other patient was even temporarily



FIG. 4.—Proximal sigmoid held in clamp. Tube is passed up to end of distal sigmoid, where it is fastened by a strong double suture passed through the intestine and eyes of tube and tied. By pulling on the tube, the sigmoid is inverted and drawn out through the anus.

cured nor made more comfortable. Several of the patients suffered unspeakable pain, apparently the result of the radium. This pain was either in the back or in the bladder, or both.

While conceding that these were far advanced cases or that the growth was in most instances located at a difficult place for removal, the prog-

ress of these cases led me to believe that we could never expect results in cancer of the rectum from radium treatment in any way comparable with results obtained by radium treatment of cancer of the uterus. In fact, I shall not use radium in cancer of the rectum again except for some very extraordinary reason. This statement is made in face of the fact that I am very enthusiastic in the advocacy of radium for cancer of the cervix—even to the point of almost excluding radical surgery in treatment of carcinoma of the uterus, except in the earlier cases or in combination with radium.

Therefore we narrow the treatment of cancer of the rectum to the field of surgery. Surgery in treatment of cancer of the rectum may be palliative or radical. Palliative is naturally limited to those cases in which radical

## TREATMENT OF CANCER OF THE RECTUM

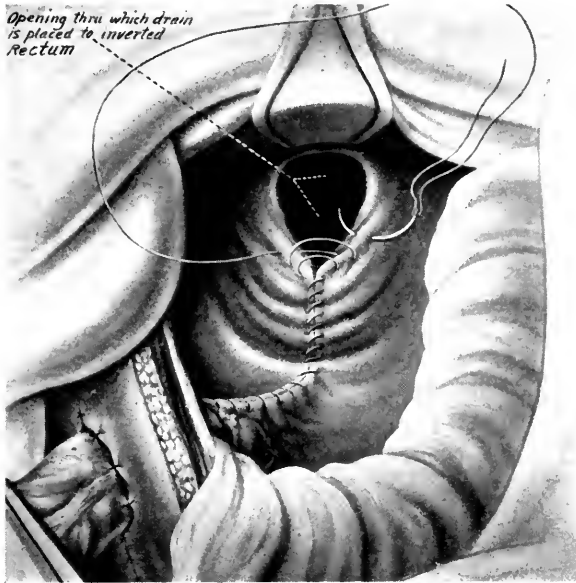


FIG. 5.—After the space between the sigmoid and the left lateral parietal peritoneum has been closed by suture, a continuous catgut is run along the mesosigmoid covering the raw fat edges with peritoneum down to the narrow portion of the cul-de-sac, where drain is inserted.

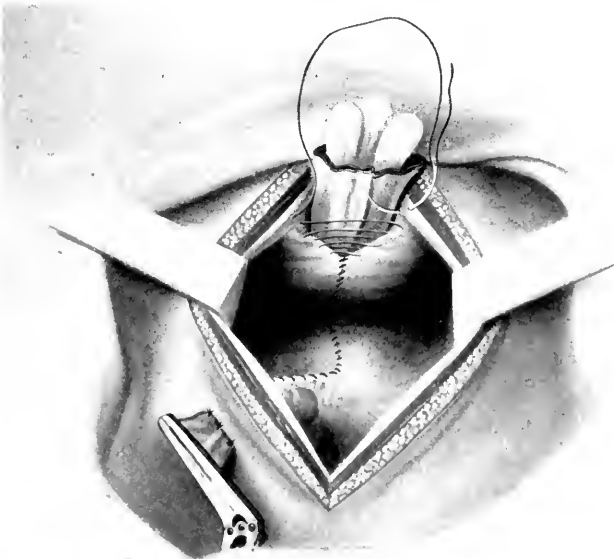


FIG. 6.—The suture line continues to bring the parietal peritoneum from the sides of the narrow pelvis around the drain until the abdominal incision is reached, making the drain extra-peritoneal.

removal is impossible, either because of too extensive local involvement of other organs or metastasis. The only hope for cure of cancer of the rectum is radical surgery.

In the past, surgery which offered reasonable hope for eradication of the disease has been so formidable as to appear almost prohibitive. The early work in the days of Kraske was accompanied by mortality of 50 or 60 per cent. Finally, development in the hands of such masters as Mayo, radical operation at one stage was reduced to about 25 per cent. One of the most dramatic fêtes of surgery fifteen or twenty years ago was the simultaneous operation in case of cancer of the rectum by Drs. W. J. and C. H. Mayo, one

operating above and the other below. Even with this combination of skill, the mortality was formidable and the end results anything but encouraging.

Then the two-stage operation came which cut the mortality almost in two, bringing it down to twelve or eighteen per cent. in the hands of the best operators.

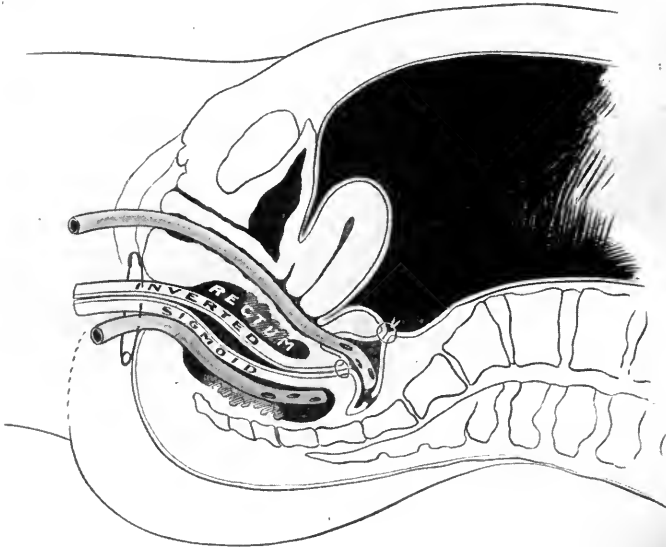


FIG. 7.—Diagram showing the supplementary drain passed through stab-wound in cul-de-sac in case of woman.

The two-stage operation performed was usually one of doing the colostomy first and doing the Kraske operation later. In other words, the major procedure was left for the last operation.

In the *ANNALS OF SURGERY*, April, 1915, I described a method of operating for cancer of the rectum in which the major procedure was done first and all the work finished in the abdomen. At this time a permanent colostomy was made. The superior hemorrhoidal artery, which is the chief blood supply of the inaccessible portion of the rectum, was doubly ligated and cut. A rectal tube which had been passed into the rectum was used to invert the distal end of the sigmoid and draw it out through the anus. This appeared to me to give less shock at the second operation than when the minor operation was done first and the major operation done later. The two principal points claimed for the operation at that time were the cutting off of the

# TREATMENT OF CANCER OF THE RECTUM

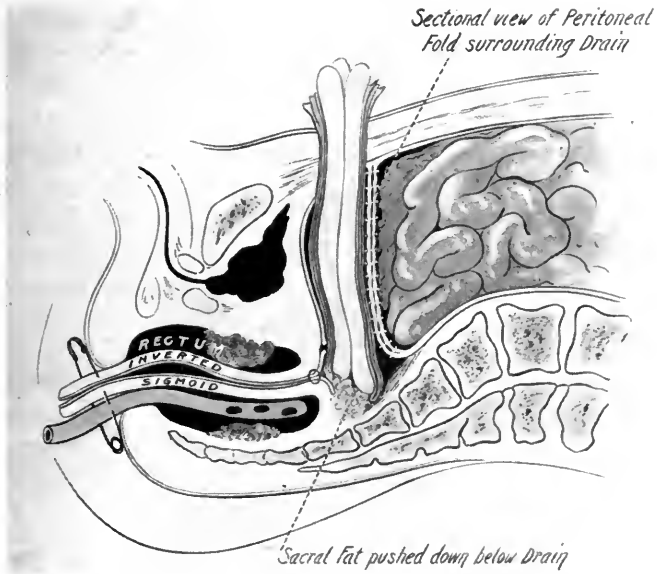


FIG. 8.—Sectional view of drains have been tubularized by the peritoneum of the pelvic wall. Fat in hollow of sacrum is pushed down, a drainage tube in rectum and inverted sigmoid held down by a safety pin.



FIG. 9.—Second stage of removal operation in woman. After incision around anus, back to coccyx, fingers are passed between rectum and vaginal wall to upper end of inverted rectum.

circulation and thus relieving one of the great dangers of the Kraske operation, second, closing the peritoneal cavity, relieving the danger of sepsis and peritonitis. We soon found that a complication arose in many of the cases. Not only the inverted sigmoid which had been devascularized by the ligation of the superior hemorrhoidal, but also the tissue in the hollow of the sacrum sloughed. This produced in the allotted ten or twelve days, which was given for the patient to recuperate from the first operation, a marked rise of temperature, lasting a week or ten days and finally an abscess would break into the rectum. This did not seem to be particularly serious, but was very undesirable and probably in a large series of cases would have produced considerable mortality. Therefore, we had to provide for drainage.

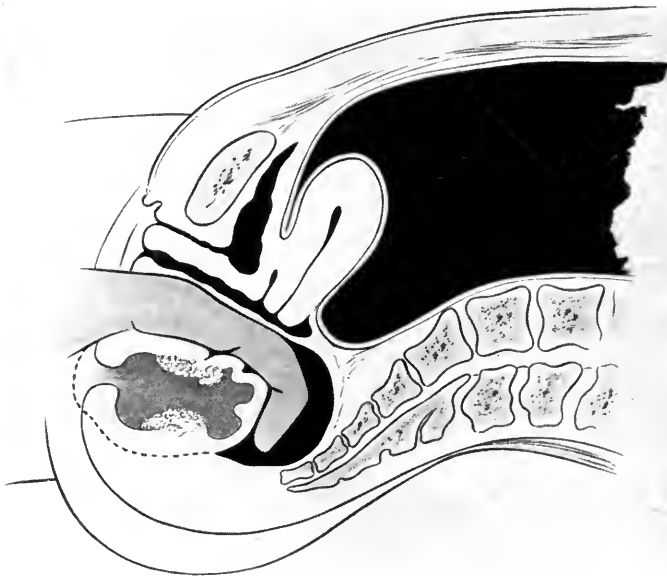


FIG. 10.—With the fingers flexed on the palm, the rectum and all the fat in the hollow of the sacrum scooped out intact.

In the female this was easy by making a stab wound through the upper end of the vagina into the cul-de-sac. The problem was quickly solved in woman, but was not so successfully solved at first in man, for it required the placing of a drain down to the end of the rectum and bringing the drain up through the peritoneal cavity. This was

not desirable and destroyed our idealism of completely finishing our work in the peritoneal cavity, but it worked quite successfully. Soon, however, we discovered that there was sufficient loose peritoneum on the wall of the narrow pelvis of man to enable us to continue our suture line used for closing the raw mesenteric borders, drawing in the loose peritoneum from the side of pelvis around our drain, making a peritoneal tube, which restored our idealism and enabled us to completely finish the operation.

The next question was that the operation, which required inversion of the bowel from above, was only applicable to those cases in which no great amount of obstruction had taken place. The operation of doing the major procedure first could not be used in that very formidable type of cases in

which the growth involved the lower pouch of peritoneum and in which stricture is the earliest manifestation. Recently we have been able to overcome this difficulty and have applied the principles of using the major procedure first in these cases in a most admirable manner by removing the growth and all the contents of the hollow of the sacrum at the first operation from the abdominal side. So we now feel that we are able to deal successfully with cancer located anywhere in the rectum, including the rectosigmoid section, which is the most formidable location of a cancer in the gastrointestinal tract, except the cardiac end of the stomach.

The operation therefore may be divided into two types: First, operation for dealing with cancer of the lower rectum, in which it is possible to pass a rectal tube beyond the growth. Second, in which the growth is located high and in which stricture and obstruction are the first serious symptoms.

*Operative Measures for the Relief of Cancer of the Lower Rectum.*—The first stage of the operation is performed as follows:

(a) A rectal tube is passed into the rectum

through the growth before the beginning of the operation. This drains any contents that may be in the bowel.

(b) An ample incision is made through the right rectus muscle about an inch to the right of the median line. Through this incision the hand is passed, the liver and all other abdominal organs, including the rectum, are examined. By this means it is determined whether or not it is possible to completely eradicate the growth. If the growth is found removable, the patient is placed in Trendelenburg's position, all the intestines are packed back with moist gauze except the sigmoid, which is left entirely exposed.

(c) The peritoneum on either side of the mesosigmoid is cut, leaving only the blood-vessels and fat in the mesentery. The cut in this peritoneum

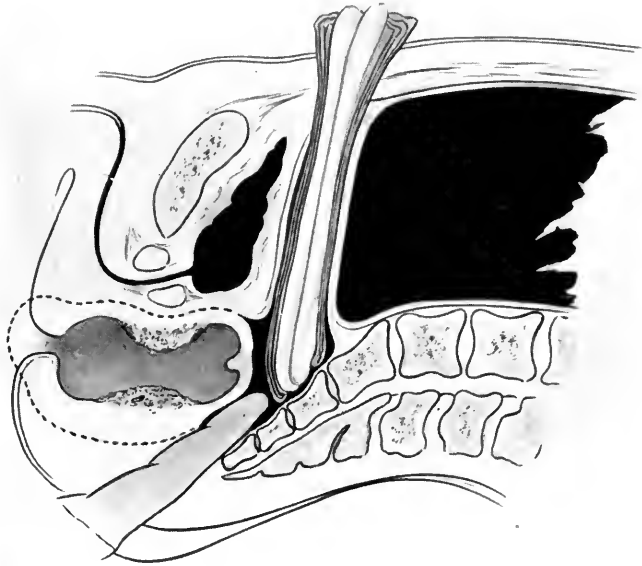


FIG. 11.—Second stage on removal operation in man. Patient is placed on face. Incision around rectum and backwards, coccyx removed, fingers of hand insinuated between rectum and sacrum until drain is touched.

is extended around the rectum between the bladder and rectum in man and between the uterus and rectum in woman. (Fig. 1.)

(d) By passing one finger between the vessels of the mesentery, the superior hemorrhoidal artery is felt pulsating between the thumb and finger. It is a large vessel and easily felt. A large artery forceps is used to grasp the artery in the mesentery above and another below the fingers and thumb. This squeezes out the tissues, leaving nothing but the artery. Two ligatures are then placed at these points and the artery is severed. (Fig. 2.) This destroys all the arterial supply to the lower sigmoid and upper rectum.

(e) In order to prevent soiling the field with venous blood, clamps or ligatures are placed on the vessels near the sigmoid, after which the vessels

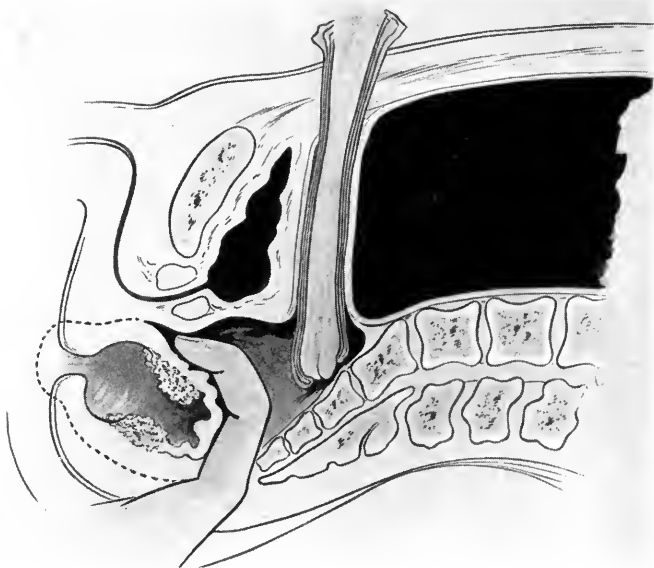


FIG. 12.—Fingers flexed on palm, separating rectum from bladder, prostate and urethra.

are cut, the fingers of the left hand passed down the hollow of the sacrum, pushing the fat ahead and separating the fat and connective tissue from the hollow of the sacrum. There is practically no bleeding during this part of the operation, but a gauze pack is placed in hollow of the sacrum while the next step in operation is performed.

(f) This consists in severing the sigmoid and making the permanent colostomy. At this stage an incision, about an inch and one-half in length and about the same distance below the level of the umbilicus, is made longitudinally through the rectus muscle about its middle, separating its fibres. Peritoneum is picked up on either side, held in forceps for convenience later, and is opened. A Payr's crushing clamp is passed through the opening in the wall on the left side and grasps the sigmoid at the point of bowel desired for making permanent colostomy, careful observation being made as to the blood supply. Another similar clamp is placed below this one through the main abdominal incision. The intestine is cut between these clamps with cautery,



and the clamps sterilized with the heat of the cautery. (Fig. 3.) This proximal end of the sigmoid is drawn out through the stab wound in the left rectus, where it is fastened to the various layers with a continuous lock stitch of small double chromic catgut. The first row fastens the peritoneum to the intestine, the second the aponeurosis and muscles, the third the skin, the skin being fastened by small interrupted chromic catgut. The clamp remains on the intestine and at the conclusion of the operation is strapped on to the patient with adhesive straps to be removed twenty-four or forty-eight hours later, as is convenient.

(g) Next step in the operation then is to turn in the distal end of the sigmoid with purse string, trim the fat of the mesentery from its sides, pass a strong thread through the eye of the rectal tube and through the walls of the intestine, pick up the two sides of the walls of the intestine and have an assistant draw on the tube from below, by which the sigmoid is inverted and drawn out through the anus. (Fig. 4.) One or two sutures may be passed across the peritoneal surface of this inverted end so as to prevent reduction of the inversion. A clamp or safety pin on the protruding gut outside the anus does this very effectually.

(h) The next step of operation consists in the restoration of unbroken peritoneal cavity, which is done in the following order: The space external to the point where the sigmoid comes through the left rectus muscle should be closed by suture, bringing the anterior, posterior and lateral peritoneal surfaces together with a firm line of sutures up to and including the mesentery of the sigmoid. From this point the posterior parietal peritoneum is drawn over the raw edges where the mesosigmoid has been cut. This line of sutures continues down to a point where it is necessary to insert the



FIG. 13.—Space from which rectum has been removed, connected with abdominal drainage canal through which irrigation may be conveniently made.

drainage. (Figs. 5 and 6.) If the patient is a woman, an assistant passes a pair of large forceps to the upper end of the vagina. The posterior vaginal wall is cut on the forceps and drawn out through the vagina, leaving an ample end in the space beneath the peritoneum and above the end of the inverted bowel. (Fig. 7.) Then the running suture is continued down across the cul-de-sac, closing all spaces. In some instances we have sutured the uterus in the hollow of the sacrum with its broad ligaments.

If the patient is a man, the peritoneum is sewed down to the point where it is necessary to insert the drain. A large cigarette drain is placed down to the hollow of the sacrum above and back of the inverted rectum. The running suture is continued by gradually drawing in the loose peritoneum

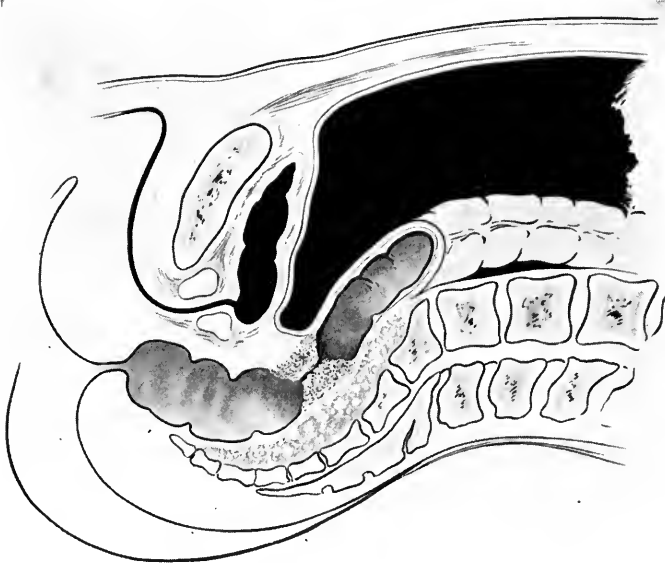


FIG. 14.—High rectal cancer producing stricture.

from the sides of the narrow male pelvis, coming forward toward the abdominal wall until finally all the distance is covered and there is a diaphragm of peritoneum which completely separates the general peritoneal cavity from the drainage canal. (Fig. 8.) In other words, the drain is in an extra-abdominal tube

of peritoneum. This drain is allowed to remain until the second operation, both for the purpose of drainage and to be used as a landmark. The main incision through the right rectus is now closed and protected from the future colostomy opening by a collodion dressing made up of one layer of gauze fastened to the skin of the abdomen, between the two cuts, by collodion, and this covered by a layer of gutta-percha and this again covered by another layer of gauze held by collodion. Finally an additional tube drain is placed in the rectum beside the protruding inverted sigmoid. A safety pin holds the tube in and the intestine out. (Figs. 6 and 7.)

The second, or removal operation, is now a minor affair for the following reasons: First, we are through with the fecal current by having a permanent colostomy. We have destroyed all possibility of serious hemorrhage and

resultant shock by ligation of the superior hemorrhoidal artery. We have removed all the difficulties attending the higher parts of the operation by pushing down all the fat and connective tissue within easy reach of the lower field. We have finished with the peritoneum and have made a clean closure by which the patient is protected from all kinds of intra-abdominal complications.

A marked cedema around the rectum seems to take place as a result of devascularization and drainage in the neighborhood, which makes the complete enucleation of the rectum and all surrounding tissues remarkably easy. It is performed as follows:

In the female the operation may be done by splitting the vagina according to Murphy's method, which is the simplest and quickest way, requiring only about two minutes to do the complete removal. Or the vaginal wall may be left, the coccyx removed, the fingers passed up between the vaginal wall and rectum until it has reached above the end of the inverted bowel and then, with the fingers curved to the

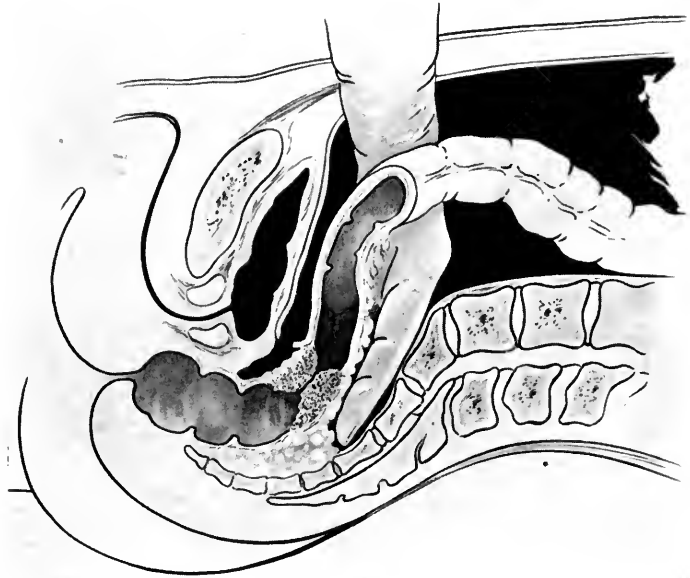


FIG. 15.—Sigmoid has been mobilized as in Fig. 2. Peritoneum around the rectum has been cut, the bladder separated from rectum down to the prostate. Fingers of left hand being insinuated between rectum and sacrum down to point of coccyx.

palm, the entire growth is peeled out with astonishing ease. (Figs. 9 and 10.) There is no bleeding except in the lower areas near the anus. The wound is now packed with a long continuous gauze sponge which controls any little oozing, takes up the sepsis, and the operation is completed.

In the male the coccyx is removed, the fingers insinuated between the end of the sacrum and the rectum, muscles on the sides are grasped and cut and the inverted bowel is brought down ahead of the fingers, which in this instance are directed away from the spine. (Figs. 11 and 12.) After the operation the entire cavity wall is easily seen and is packed with gauze lightly. The pack is left about three or four days and is removed. The upper

drain is removed and irrigation is made by running a catheter down through the front drainage canal, irrigating out backwards. This is the easiest way we have found to take care of these wounds. I have tried a number of these cases by partially suturing these wounds, but I have about reached the conclusion that if only the coccyx is removed, it is just as well to leave wound wide open. (Fig. 13.) Patient is on his feet in two weeks and there is never any complication in the way of obstruction of drainage before wound is completely healed. It, of course, is a matter of several weeks before the wound is completely closed.

*Operative Measures for Relief of Cancer of the Upper Rectum or Recto-sigmoid.*—The first operation for removal of cancer located at the recto-

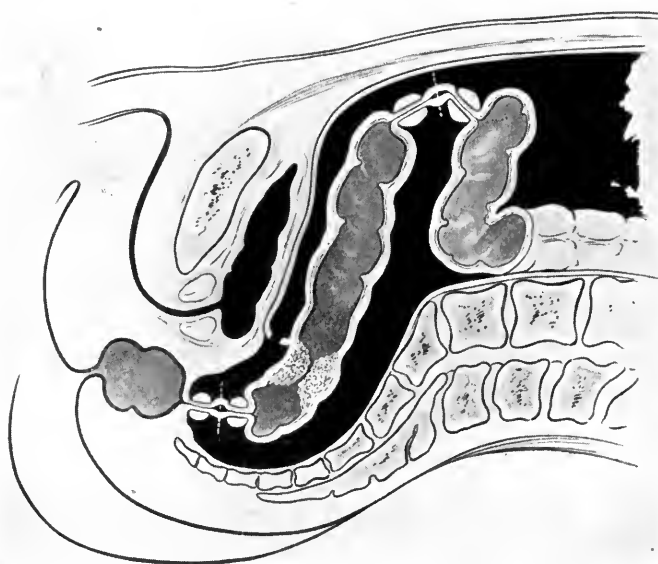


FIG. 16.—The freed bowel is doubly clamped above by Payr's clamps as in Fig. 3, and severed. Below, it is doubly clamped by long-handled clamps and severed, after which intestine with growth is removed.

sigmoid junction, and which involves the peritoneum and produces a stricture (Fig. 14), is performed as follows:

(a) The sigmoid is mobilized as in the previous description for removal of the cancer of the lower rectum with the addition that the separation of the bowel and perirectal tissue in the hollow of the sacrum is carried

down to the end of the coccyx and the rectum is separated from the bladder down to the prostate. (Fig. 15.)

(b) The sigmoid intended for the colostomy opening is seized by the Payr's clamp which has been inserted through the left rectus opening, just as in the operation previously described for removal of cancer of the lower rectum. Another clamp is placed immediately below it, passing through the main abdominal incision, intestine is cut, both clamps sterilized with cautery, the proximal end is brought out and colostomy completed just as in the other type of operation. The rectum is drawn up taut, the bladder is drawn forward, a large hysterectomy clamp grasps the rectum down as close as possible to the sphincter, approximately an inch or two, another clamp is placed just

above it and the intestine is cut between the two. (Fig. 16.) By this means the cut is about two inches below the growth. All of the distal part of the sigmoid, most of the rectum, all the fat and tissue in the hollow of the sacrum, along with the growth, are removed completely at this operation. The handle of the lower clamp on the rectum is included in the same peritoneal tube which carries the large cigarette drain. (Fig. 17.) This clamp is removed in forty-eight hours.

In these cases, after the growth with the upper rectum has been removed from above and only a short piece of rectum is left, the stub of the rectum, after the completion of the operation, should be cleansed and packed with gauze.

In high recto-sigmoid cancer, in which we have completed the operation of removal of the growth at the first operation, and have only to remove the lower segment of the rectum at the second operation, we cut back through the sphincter to the tip of the coccyx, passing two or three fingers up to the end of the mucous membrane, peeling it

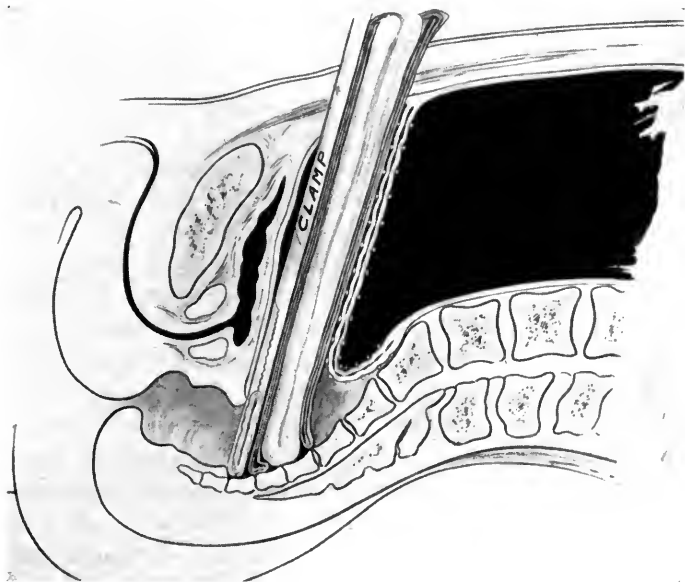


FIG. 17.—The handle of clamp holding stub of rectum is brought out through peritoneal tube with cigarette drain.

down to the anus, either with or without the removal of the sphincter muscle. In this way the contour of the buttocks and perineum remain unchanged by the operation except that the rectum has been removed. The question of drainage is a little more difficult, for drainage must be kept up in all these cases until the cavity in the hollow of the sacrum has filled.

If the contour of the anus and gluteal regions are to be preserved, special attention must be given to the drainage. After the temporary drain put in at time of operation has been removed about the third day, a large rubber tube is passed through the abdominal wound and out through the anal wound. One side of the tube is cut out at the angle of the abdominal tube with the anal tube, so that drainage may take place either way. A short tube of the

same size is placed in the anal wound and pinned to the long tube. This extends up three or four inches and helps to keep the lower wound open for a few days and also drain area in the hollow of the sacrum. This is irrigated by passing the solution through the tube coming out through the abdominal side and out through the other wound. In about a week or ten days, the short tube is removed, safety pin is placed in the upper end and lower end. Irrigation is continued until the lower canal begins to fit snugly around the tube. Then Dakin solution is used for a week or such a matter, being held in by clamping the lower tube. A few days later, a smaller tube of same kind is inserted and Dakin's solution continued. Finally a very small tube, which is made a half tube at its centre, is used. The irrigation, first with water and then Dakin's solution, continues. Finally the lower end of the tube is cut off and upper one gradually withdrawn, Dakin's solution being inserted from upper wound and made to run out through the lower wound as long as it will. This produces the most ideal result in that there is no deformity of the gluteal regions, although it requires a great deal of time and care in completing.

*Results.*—In an experience of more than 100 cases of cancer of the rectum, surgically treated, thirty-seven have been treated by the method of completing the major procedure first in the two-stage operation. Of these there have been two deaths, one from shock because of the far advanced state of the cancer, removal of which resulted in tearing the internal iliac vessels, also tearing of the ureter. The other was due to deficiency in kidney function, the patient dying of uræmia, about a week after operation, which gives us a mortality of 5.4 per cent. This, of course, is too small a number on which to base statistics when we consider the mortality rate alone, but in our experience when we take into consideration almost complete absence of shock and complications, I feel sure that any multiple of this number of cases would probably bring equally as good a record, if not better.

*Operability.*—By this method of doing the major part of the work from the abdominal side and removal of all possible elements of danger at the first operation, which could complicate the second operation, we should consider no case of cancer of the rectum inoperable except insofar as it involves other important adjacent organs or metastatic areas.

## THE SURGICAL RELIEF OF INTESTINAL FOCI OF INFECTION IN CASES OF ARTHRITIS DEFORMANS

BY REA SMITH, M.D.

OF LOS ANGELES, CALIF.

IN 1915 the writer reported before the Surgical Section of the American Medical Association, a series of fourteen cases of chronic arthritis operated upon for the removal of an intestinal focal infection. Of this list two have died, four are untraced, three are not improved, one has had a complete arrest of the disease, but is unable to walk on account of joint fixation. Four are restored to normal activity. We attribute our failure to show a higher percentage of cures to our surgery. These early patients were all operated upon with the Lane technic, which was followed in a large proportion of cases by intra-abdominal adhesions which defeated the surgical aim by preventing the relief of the intestinal blockade. We learned in 1915 the cause of these adhesions and a simple way to avoid them, and have not been troubled by recurrence of stasis since then, even when an operative procedure of the Lane type was used.

From our observation of these patients since 1913, we are of the opinion that the disease has its origin in a focal infection in the intestinal tract due to an unbalanced or perverted intestinal flora made possible by the failure of some part of the ileocæcal coil to empty itself properly.

Infections of the teeth and tonsils are undoubtedly the cause of many cases of arthritis, especially of recent origin, and their removal quickly clears up the symptoms. But in chronic cases the removal of tonsils and teeth has, as a rule, very little permanent effect. The reason being that an intestinal infection has taken place and a larger focus developed, so that then the clearing up of the head foci hardly affects the load of infection at all.

In the examination of the intestinal tract of more than one hundred cases of chronic arthritis with the X-ray, we have been surprised at the similarity of the picture of the ileocæcal coil, and have come to the conclusion that the typical soil for development of arthritis is a congenital mobile cæcum, which has been tacked back to the side wall of the abdomen by nature in an effort to lift up and anchor a prolapsing organ.

By a reduplication of peritoneum starting at the right colic artery and extending to the parietal peritoneum over the right kidney, the colon is rolled and folded so that it gives the appearance of an hour-glass, with the cæcum thin-walled and toneless. This seems to be an exaggeration of the condition first described by Jabez Jackson and known as Jackson's membrane. There is usually a binding down of the ileum somewhere in its terminal eight inches, increasing the torsion in the ascending colon so that the physiological function of the colon is crippled and the cæcum becomes an inert sac, which does not empty itself. This sac constantly filled with culture medium becomes

infected with streptococcus, either from a head infection or from the terminal ileum, which is the natural habitat of the streptococcus veridens. The streptococcus becomes then the predominating colon organism and we have an overbalanced or perverted flora resulting, which in its turn becomes the focus of infection and which keeps up the arthritic disease caused by the original head focus or itself becomes an original focus and brings about the disease.

The last thirty cases of this series have all had preliminary stool examinations by Barrows and have all shown amœbæ and flagellate protozoa in great numbers. I have been of the opinion that they had to do with the stasis and played a secondary rôle in the infection, perhaps by furnishing culture media for bacterial growth, or by their passage through the mucous membrane furnished a portal of entrance to the circulation for bacteria. But Ely reports in the *California State Medical Journal* of February, 1922, the finding of amœba histolytica in the head of a femur removed from a patient with arthritis deformans. This was confirmed by Kofoed in the same journal. The finding of this organism *once* does not prove that it is a cause of arthritis, but it is significant, and of especial interest to me because of its intestinal origin. We *do* know that these parasites are present in all of our cases of chronic arthritis examined for them and that they decrease very rapidly under the administration of liquid paraffin.

We have endeavored by medical and surgical means to eradicate this focal infection and I have a group of sixty-eight operative cases which I will present for your consideration. We will divide the list into two groups: The old ones operated upon before October, 1917, and the *new* group, operated upon since 1920, the interval being due to the break in routine work made by the war.

Of the old group comprising thirty cases, we have ten who were bed-ridden and helpless when operated upon, now able to work with their hands and be self-supporting. These all had partial colectomy or ileosigmoidostomy. A good many of the cases we have been unable to trace and a good many have died from intercurrent disease. The patient whom I demonstrated in 1915, one year after her operation, is still earning her living in Los Angeles as a general nurse (although she is over sixty years old) and has had no recurrence of symptoms.

In the new list comprising thirty-eight cases operated upon since June, 1920, we have eight Mayo right-sided colectomies, two ileosigmoidostomies and twenty-eight plastic operations on the ileocæcal coil designed to restore the impaired physiological function of the cæcum and do away with the sac that breeds the focal infection. There is usually an immediate alleviation of the symptoms of pain, swelling and joint immobility, which unfortunately is not permanent, because the patient still has a perverted intestinal flora and the operation is often followed by a rather severe joint reaction. However, with restricted diet, based upon a bacterial analysis of the stool, liquid



paraffin and abdominal support, the flora gradually returns to normal and the patients progressively improve.

If there is no mechanical intestinal abnormality, but instead a general colon sluggishness, the after-surgical treatment, without the surgery, will produce the same result. We have in a number of cases had great symptomatic improvement treated in this manner without any surgical procedure. Other patients treated medically without any improvement, have had an immediate relief of symptoms after a surgical procedure to remove the intestinal blockade, and then returning to the same medical régime.

The most striking immediate results follow the removal of the right colon, and here lies the proof of the colonic origin of the disease. The removal of the right colon deprives the patient of his filter and for ten days there is practically no water absorbed by the intestinal tract. It becomes necessary to give this patient water under the skin to prevent dehydration and our routine is a quart of salt solution daily by hypodermoclysis until the quantity of urine jumps from 1000 to 2000 c.c. This happens usually from the tenth to the twelfth day. During this ten-day period our patient makes a wonderful recovery from joint trouble. In forty-eight to seventy-two hours the swelling disappears and the joints become more and more movable and the pain entirely disappears, but on the day the urine doubles, showing that the intestinal tract is again absorbing water, the joint symptoms recur. The perverted flora is still able to act as a focal infection and the joints then clear up slowly as the flora returns to normal. The ileosigmoidostomy cases act in the same way because we use a tube through the sigmoid into the ileum and no water reaches the cæcum. The cases that are operated upon to restore function by releasing constricting bands and correcting pulls and counter-pulls, that prevent the physiological contraction of the muscle walls of the cæcum, do not have this spectacular early remission of symptoms, but slowly get better and as the unbalanced intestinal flora regains its normal balance the joint symptoms disappear.

The interference with physiological function of the cæcum is easily demonstrated by dividing the constricting band with a sharp knife at its junction with the parietal peritoneum. The ascending colon immediately rolls out until three or four inches separate the ends of the divided band and the cæcum regains its normal color and contracts upon mechanical stimulation. We think that the interposition of tissue is the most important step in preventing recurrence and use free omental grafts to fill in all gaps and cover all denuded surfaces.

We have found the unpuckered mesoappendix spread out and turned over towards the midline most useful in covering the denuded surface developing on the mesentery of the ileum upon the division of a "Lane's kink," and think that again the interposition of tissue is most important in preventing a recontraction of peritoneal surfaces and a redevelopment of the kink. We always drain with a flat rubber drain for twenty-four hours, after breaking up adhesions around the colon and thereby save our patients from a wide-

spread local peritonitis which is in itself likely to cause adhesions and interfere with the results of the operation.

In this new group of thirty-eight cases we have had eight in which the colon, after freeing, was such an inert bag that we deemed it better to remove than to trust to its regaining its tone. Two who had a good colon and a *small* intestine block only were short-circuited, which operation is only safe when the colon has good tone and is unobstructed. Twenty-eight had a simple operation amounting to the removal of the appendix, releasing bands and covering denuded surfaces. There were three deaths in the surgical period in this series, two of heart block on the fifth day after operation, coming on suddenly in the course of an uneventful surgical convalescence, both having crippled hearts from many recurrent acute attacks of their old infection. One died from a low-grade wound infection.

The joints become amenable to orthopædic treatment as soon as the pain subsides, and operations and manipulations can be carried out without fear of lighting up another attack of acute inflammation, which always hampers the orthopædic surgeon when he attempts any radical procedure in the presence of the infection.

In conclusion, we believe that we have clinical proof that chronic poly-arthritis is the result of a focal infection located in the ileocæcal coil. That no study of a case of arthritis is complete without a careful investigation of the gastro-intestinal tract, especially of the ileocæcal coil for both motility and mobility. In the event that a pocket exists in the intestine, the rational procedure is first an abdominal operation to straighten out bad mechanics and restore function to the cæcum, a prolonged medical régime to restore the unbalanced intestinal flora to normal and then such orthopædic procedures as are necessary to restore function to damaged joints.

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## LIGATION OF THE AORTA\*

NECROPSY TWO YEARS AND ONE MONTH AFTER OPERATION

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SEPTEMBER 27, 1921, the patient was examined and demonstrated to a class of medical students. The physical signs were about the same as at the last examination, except that the whining sound noticed before was no longer heard. He was at work and expressed himself as feeling perfectly well.

December 18, 1921, patient examined on account of pain in lower part of left side of the chest, thought to be a slight pleurisy. Otherwise no change observed.

January 27, 1922, the patient was taken with violent pain in the abdomen, almost collapsed, and was taken to hospital, where after a cystoscopic examination a diagnosis of displacement of the right kidney and obstruction of the ureter was made. An operation was undertaken to relieve this trouble, the kidney was exposed and found to be pushed downward by a large pulsating mass and the operator thought it wise to proceed no further with the operation. So the wound was closed around a drain. There was a slight bloody discharge from the wound during the next two weeks and the patient gradually weakened until his death, February 25th, two years, one month, and two days after ligation of the aorta.

*Necropsy.*—Numerous adhesions about the stomach and great omentum, vessels of latter dilated. Inferior mesenteric artery and branches dilated considerably. The peritoneum over the aneurism was unbroken and there was no evidence of rupture or the escape of blood to account for death. The aneurism sprang from the posterior wall of the aorta by a large mouth opposite the origin of the superior mesenteric and renal arteries, and extended slightly to the left, but chiefly to the right, behind the peritoneum, eroding the bodies of the second, third and fourth lumbar vertebræ and involving the sheath of the right psoas muscle. It measured seven inches from above downward and six inches transversely and was filled with a large, firm, reddish-white clot, no fluid blood except a little at the lower end in the psoas sheath. It was a very large, hard clot and did not seem to interfere with the lumen of the aorta.

The ligature was found surrounded by thick connective tissue which completely concealed it from view. The loop measured one-fourth of an inch in diameter; there was no sign of absorption and it was buried in the coats of the aorta, having cut through the intima on the left, but on the right side was separated from the lumen of the vessel by the intima. The left common iliac artery was open and continuous with the lumen of the aorta above the ligature, while the right common iliac was completely closed by organized clot or connective tissue. No atheromatous patches were found in the aorta.

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## LIGATION OF THE INTERNAL ILIAC FOR ENORMOUS GLUTEAL ANEURISM\*

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CIRSOID ANEURISM OF THE SCALP

ANY of the branches of the internal iliac or hypogastric artery may become aneurismal. They are intra-abdominal or intraperitoneal, except those that occur in the peripheral branches, as the gluteal, sciatic, obturator, pubic, etc. Those of extrapelvic origin often extend into the pelvis, and some of intrapelvic origin may be extrapelvic as well. The sacro-sciatic notch forms the groove between the sacs. They are described as pelvic aneurisms but are more commonly designated as aneurisms of the buttocks. These dilations or extravasations are the gluteal or sciatic arteries and occur more frequently than those of the other branches.

Iliac aneurisms appeared eleven times in Crisp's classic group of 551 aneurisms, five of these being of the internal iliac, making less than one per cent. of all aneurisms in his collection. The incidence of gluteal aneurism is, therefore, a much smaller per cent. Of twenty-one patients reported by Ott<sup>12</sup> with aneurisms exclusive of thoracic aneurisms operated at the Mayo Clinic between January, 1907, and November, 1918, in only one was the internal iliac ligated. Rupp,<sup>13</sup> in 1907, was able to collect forty-five cases. From 1916 to date only five new cases of gluteal aneurisms have been reported in the available literature.

For the most part gluteal aneurisms are traumatic from direct or indirect violence, however, no history may be obtained of injury and they are described as spontaneous. Aneurisms of the buttocks are ordinarily of the circumscribed traumatic type. Of the twenty-eight cases mentioned by Matas<sup>10</sup> in his very comprehensive article, twelve were due to wounds (stabs) and twelve to ruptures or lacerations caused by fracture of the pelvis or contusion, falls on the seat, etc. Goldammer<sup>6</sup> reports one case developing shortly after being beaten with a board. Matas further says "the gluteal artery is more frequently injured by direct wounds (stabs); the sciatic by falls on the ischium or seat, which fractures the pelvis or tears the artery at its exit from the sacro-sciatic foramen." In Rupp's collection of forty-five gluteal aneurisms, twenty-two were of traumatic origin and twenty-three spontaneous. Eight of these twenty-three were indirectly associated with trauma. Indirect traumatism, including the rupturing effect of sudden, violent efforts, as lifting, wrestling, are to be regarded as exciting causes only when pathological conditions, such as atheroma exist as a predisposing condition. The left side is more frequently involved but they may be bilateral. The vast majority occur

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## LIGATION OF THE INTERNAL ILIAC

in men and are most frequent between the twentieth and fortieth years. The size of the aneurism may vary from that of a small apple to that of a huge tumor, which fills the larger part of the pelvis and externally appears as enormous tumor as large as an inverted salad bowl.

The symptoms vary according to its size, origin, proximity to, and pressure upon, the adjacent structures. An expansile, pulsating tumor appearing after traumatism is suggestive of aneurism. A thrill may be felt or on osculation a



FIG. 1.—Gluteal aneurism, treated by ligation of the internal iliac artery.

bruit may be elicited. The spontaneous tumors are slow in developing but the traumatic are usually rapid in growth and are large and diffuse. On account of the pressure on the sciatic nerve, the early symptoms are often considered to be a sciatica. It is only when a tumor can be made out that the diagnosis can be certainly established. Aneurisms of the sciatic branch are more movable than aneurisms of the gluteal and are in closer proximity to the ischium. These aneurisms when they do not pulsate or are filled with hard clots may be mistaken for osteosarcoma or lymphosarcoma, abscess or other tumors. Röntgen-ray and exploration with aspirating needle often aid in determining the exact nature of the condition. This, together with a careful history, accurate physical findings and necessary laboratory data, will usually give the diagnosis.

Matas warns that "these large gluteal aneurisms tend to rupture spon-

taneously and sometimes choke up the thigh with massive extravasations of blood, causing death from hemorrhage very rapidly." The prognosis is excellent with modern surgical methods of to-day.

The older methods of treatment have all given way to surgical treatment. Coagulation by the injection of boiling water or chemicals, galvano-puncture, etc., have been discarded in favor of modern surgery. The first ligation of the internal iliac was done by the extraperitoneal route by Stephens, of Vera Cruz, in 1812. Of twenty-six ligations of this vessel on the Hunterian plan, eighteen were fatal. It was a dangerous operation as only a few were done antiseptically. D'Antona,<sup>3</sup> of Naples, published all the reported cases of ligation of this artery from 1869-1903. There were in all twenty-five cases with fifteen recoveries. Many of these were in the preantiseptic era which explains in part the forty per cent. mortality. Following this there was introduced the now old operation, a modified Antyllian as performed by Syme as the method of "intrasaccular ligature," with a mortality of sixteen and sixty-six hundredths per cent. in the fourteen cases reported by Delbet. The ligation of the internal iliac by the intraperitoneal route at the present time is a comparatively simple and satisfactory procedure. This method, unfortunately, will not cure all cases as the results are sometimes uncertain: Gillette reports one case with recurrence after seven years, which necessitated reoperation and ligation of the external iliac for a cure. These results can still be further improved with modern technic; that is, a combination of ligation of the internal iliac whether permanent or provisional, with free excision of the sac and its obliteration by sutures which is described by Matas, as obliterative endoaneurismorrhaphy. This technic is well illustrated and described in a case reported by Abbee.<sup>1</sup> This is the method of election in well-developed aneurisms with a definite sac wall "provided prophylactic hæmostasis can be obtained by preliminary intraperitoneal ligation or temporary compression of the internal iliac." The wisdom of this procedure is illustrated by a case of large traumatic gluteal aneurism reported by Frost.<sup>5</sup> It was thought that it could be controlled by a buttock incision, but when the fascia was incised, "there was a sudden spurt of arterial blood rising upward some four feet." Only the prompt packing of the sac with gauze and immediate ligation of the internal iliac, for which he was prepared, saved the life of this patient and also cured the aneurism. The same prophylactic hæmostatic method should be adopted in the treatment of the acute traumatic aneurism without definite sac wall, and the injured artery should be tied or the sac sutured as the case may demand.

The small traumatic aneurism or the small pathological aneurisms which are well defined outside of the sacro-sciatic notch are best treated by exposing the sac in its entirety and then extirpating it. Such a case of small traumatic aneurism was successfully operated by Krische<sup>8</sup> under lumbar anæsthesia. In gluteal aneurisms which begin in the pelvis, ligation of the internal iliac as near the aneurism as possible with continuous external pressure, approxi-

inating the empty sac wall until agglutination has taken place, may be sufficient to produce a permanent cure.

The ligation of the internal iliac or its branches does not compromise the nutrition or vitality of the lower extremity. This is due to free anastomosis of its branches and abundant collateral circulation. Quoting from Professor Owen (Gray's Anatomy): "In ligation of the internal iliac, collateral circulation is carried on by the anastomosis of the uterine and ovarian arteries; of the opposite vesical arteries; of the hemorrhoidal branches of the internal iliac with those from the inferior mesenteric; of the obturator artery, by means of its pubic branch, with the vessel of the opposite side and with the epigastric and internal circumflex; of the circumflex and perforating branches of the profunda femoris with the sciatic; of the gluteal with the posterior branches of the sacral arteries; of the iliolumbar with the last lumbar; of the lateral sacral with the middle sacral; and of the circumflex iliac with the iliolumbar and gluteal."

There are so few enormous gluteal aneurisms reported in the literature which have been successfully treated, that the following case is submitted:

File A 12295. A white woman, sixty-five years old, complained of intolerable pain in her right leg a throbbing tumor of the right buttock. She had enjoyed comparatively good health all of her life, having no serious illness or injury. For a number of years she had been having trouble with cramp-like pains in the calf of her right leg and would have to have it massaged before she could walk. This became gradually worse. During the six weeks prior to her entrance into the hospital, she had three or four attacks of excruciating pain in the calf of her right leg, referred up the posterior thigh to the right hip, necessitating morphin for relief. The pain is paroxysmal in character, during which time she is unable to move her right leg. She is never entirely free of pain in her right leg.

For the past three years she has noticed a swelling and throbbing in the right buttock, like a "heart-beat." This seemed to gradually increase in size, but never gave much trouble. During the past two weeks it has rapidly increased in size until it is as large as an inverted salad bowl. The pain in the swelling and in the leg has been so severe the past two days that she has had to be in bed and has been unable to move her right leg. Prior to that time she was up and about, walking with a slight limp. She has never had any swelling or discoloration of her limbs.

*Physical Examination.*—Patient is a rather poorly nourished, white female, about sixty-five years of age and weighing 106 pounds. General physical examination was negative, except for the condition of her heart and right buttock. There is a soft, blowing, systolic murmur, heard better at the apex and transmitted to the right axilla. Pulmonic second sound was accentuated, but no enlargement of the heart was made out. Rate, 115; temperature, 99.2°; respiration, 24.

There is a large, diffuse, pulsating, expansile tumor of the entire right buttock. The tumor is soft, compressible, and a thrill and a bruit are made out over its entirety. The movements of the knee and the right hip are free but painful (Fig. 1).

*Laboratory Examinations.*—(1) The urine was negative except for a trace of albumin and an occasional hyalin and granular cast. (2) Blood group (Morse technic), Type 2. (3) Wassermann reaction (acetone insoluble antigen) 2 plus;

cholesterin antigen negative. (4) White blood-cells, 6200; hæmoglobin, seventy-five per cent.

*Diagnosis.*—Aneurism of right buttock, probably of gluteal artery; compensating mitral regurgitation.

Patient was very weak and in poor general physical condition, not having slept or eaten much for the last two weeks. Pain was so severe that she had to have morphin every four to six hours for relief. She slept but little and her mental condition was confused.

She was under observation in the hospital for one week with abundant food, fluids and rest. It was planned to ligate the internal iliac artery and possibly do an intrasacculary suture (endo-aneurismorrhaphy), as described by Matas and effectively demonstrated in one case by Robert Abbee, and then if necessary do a blood transfusion. At the end of the week her general condition was somewhat better but the tumor was still apparently enlarging, so an immediate operation was advised.

*Operation.*—September 10, 1921. In moderate Trendelenburg position, and through a right rectus incision with the intestines well packed off, the right internal iliac artery was exposed without difficulty. It was found to be as large as one's little finger and a thrill was elicited by the examining finger. By pressure upon it the pulsation in the tumor was stopped. The external iliac was normal in size, as was the common iliac. Two heavy silk ligatures were tied around the internal iliac one-fourth inch from its origin and another heavy silk ligature was placed one-fourth inch lower down. The posterior peritoneum was sutured over the vessels. The appendix was seen; it appeared normal and was not removed. The wound was closed without drainage. In order to facilitate the agglutination of the wall of the aneurismal sac it was emptied by firm pressure and a large pad was very tightly strapped over it. After the operation the pulse was 104 and of good volume. The pain in the right leg was relieved for the first time in over two weeks.

The convalescence was uneventful. The temperature, which was 104° the day following operation, gradually subsided to normal on the sixth day. She required morphin only occasionally for the first few days for abdominal discomfort. There was never a return of the excruciating pain in the right leg. The pulsation of the tumor, which previously lifted the body perceptibly from the bed, became quiet and the bruit and thrill disappeared entirely.

It had been planned to do an obliterative endo-aneurismorrhaphy as a second stage following the ligation of the internal iliac, but after the aneurismal tumor was so completely stilled by the former procedure it did not seem necessary. It is agreed that the methods introduced by Matas in the treatment of aneurisms are ideal in an artery in continuity; but in a location like the buttock, a deliberate incision into such an enormous blood tumor, which this case presented, without preliminary circulatory control, seemed unwise.

The patient left the hospital on the nineteenth day, and has been up and about on crutches since that time, gaining in weight and strength and is entirely free of pain. When relieved of her intolerable suffering, her mental condition returned to its normal state.

#### CIRSOID ANEURISM OF THE SCALP

This curious, rare, disfiguring and often dangerous affection was classified by Virchow among the blood-vessel tumors, and has been called "Ranke-mangiom" or "angioma arteriale racemosum," or aneurism by anastomosis. The uncertainty regarding its morbid anatomy and etiology makes it a malady which needs further study.



According to Matas<sup>11</sup> the process shows itself as a subcutaneous swelling made up of a pulsating network of arterial sinuses, from which radiate pulsating vessels that can be distinguished as individual trunks. However, it is difficult to establish whether these trunks originally contained arterial or venous blood. It is supposed to start as a widening or dilating of the branches of a particular arterial tree. It most commonly affects the vessels of the face and scalp; next the forearm and hand. The widening, thickening and lengthening of the arteries extend ultimately to the finest capillary. Traumatism or pregnancy has been known to play a part in exciting the transformation of the vessels. Lexer is of the opinion that some developmental fault which affects the particular vascular territory concerned lies at the bottom of the process.

The diagnosis is made almost instantly by sight, while the touch confirms the impression of the arterial character of the vermiform tangle of dilated blood-vessels. A systolic blow and thrill may be transmitted to the palpating hand. A systolic murmur may be present and pressure on no one point obliterates the bruit.

The complications are many. There is a distressing thrill and pulsation, and there may be subjective symptoms of noises in the head, dizziness or fainting spells. There may be pain from inflammatory involvement of adjacent nerves. The overlying skin sometimes becomes ulcerated and produces fatal hemorrhage or severe resulting infection.

No form of treatment has met with uniform success. Central ligation of the main artery has proven unavailing or has given only temporary relief. Effort to produce solidification of the vessels and thrombosis by injection of alcohol and boiling water is not without danger. Wyeth reports a case involving half of the scalp cured by the injection of boiling water. At repeated operation, parts of the scalp bearing the aneurism have been removed, allowing the wound to heal before each successive operation. Another method was to excise the scalp bearing the aneurism and later fill in the gap with skin graft. The best method, however, is complete extirpation with ligation of all the radiating trunks. It is the ideal method, but, unfortunately, often impossible where much of the scalp is affected.

Case Report No. A11564. A woman twenty-five years of age, presented herself, complaining chiefly of a pulsating tumor of left scalp. Ten years ago she noticed a small, soft tumor, the size of the end of her finger, in the left parietal region near the median line and posterior to the occipito-parietal suture. No history of injury antedated the appearance of the tumor. There was no pain, but it was slightly tender to pressure. It never gave any trouble, but gradually increased in size until the present time. It is now about the size of a flattened goose-egg, with tortuous branches spreading out to the zygomatic arch on the left, and across the median line to the opposite parietal region and posteriorly toward the occipital region. For the past two or three years she has had pain of a more or less dull, throbbing character, especially marked in the eyes and in the frontal and occipital regions. It is usually worse when lying down. She notices the throbbing more when she reads or sews much at a time. Occasionally, she has a feeling as if something is pulling her hair.

Her general health otherwise has been excellent. Menstrual history is normal. She has been married for five years and has one child, three years of age. She has had no miscarriages. She had measles, mumps, whooping cough, chicken-pox and malaria when a child. She had influenza about three years ago. There is no history of venereal infections or injury. A small fatty tumor was removed from in front of the right ear three years ago.

Father, mother, three brothers, two sisters, husband and one child are living and well. Father has a fatty tumor of neck. One brother has a deformity of lip. Family history is negative for tuberculosis, cancer or nervousness.



FIG. 2.—Cirsoid aneurism of the scalp.

*General physical examination* was negative except for the scalp. The left anterior half of the scalp is covered with a large tumor-like aggregation of dilated, tortuous, pulsating, bluish-tinted, elevated blood-vessels (Fig. 2). Just to left of median line is a larger mass, size of a child's hand, with tortuous pulsating branches radiating out to the left zygomatic arch and across the median line to the right parietal region and posterior toward the occipital region. It feels like a bunch of worms or a varicocele, except it is pulsating, expansile, and a thrill is felt and a bruit heard. Pressure on the external carotid artery lessened but did not stop the pulsation. Röntgen-ray of head was negative for erosions along the long-

itudinal sinus. Laboratory examination of the blood and urine was negative.

*Diagnosis.*—*Cirsoid aneurism of scalp.*

*Operation.*—April 1, 1921. Patient was placed face downward with the head at the end of the table and a tight hæmostatic elastic band was applied around the head. A transverse incision was made, inch by inch, from the left middle temporal region to the right parietal region, well in hairline. The incision was made through the skin and epicranial aponeurosis skirting the growth posteriorly, making a slight U-shaped flap with the base anterior. The flap was reflected from the cranium forward, requiring many hæmostats and ligatures because of the free anastomosis with the deep vessels. The field was made comparatively dry as we proceeded. The entire tumor was ligated, posteriorly, the right occipital and anteriorly, the right temporal arteries were greatly enlarged but were not ligated. The wound was sutured in usual manner with one small tube for drainage. Oozing from the left end of the wound was controlled by iodoform gauze.

There was slight oozing for twenty-four hours, but this was not alarming. The eyes and face were somewhat swollen next day, which gradually increased, and the eyes were closed and face and neck were œdematous on the third and fourth days. This gradually disappeared under boric acid dressing and external applications of heat. The patient was dismissed from the hospital on the sixteenth

## LIGATION OF THE INTERNAL ILIAC

day, with the wound practically healed, except a small area above the left ear. Eight months after the operation there is no evidence of a return of the trouble and the patient is entirely free of the throbbing headaches.

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## PERIPHERAL NERVE INJURIES ASSOCIATED WITH FRACTURES \*

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It is impossible to determine the frequency with which nerve injuries are associated with or complicate fractures. Undoubtedly many of the slighter injuries are not noted. Many of the severe injuries are not regarded as worthy of discussion because of spontaneous recovery of the paralysis. Such injuries, when they exist, increase and prolong so much the disability associated with the fracture that it seems advisable to report the series of cases included in this paper and to analyze those already reported, in order to determine if possible the most common lesions and to suggest a line of treatment based upon the data recorded, which will lessen the length of disability and decrease to the maximum the amount and extent of the paralysis.

The following cases have been studied in the different surgical services of the Presbyterian Hospital of Chicago. An abstract only of each case is here given. Fuller details will be found in the Transactions of the American Surgical Association for 1922.

CASE I.—*Left musculospiral paralysis* developing some weeks after fracture of the clavicle. Difficult to explain the cause of the rather late secondary paralysis. No lesion of the humerus. Final outcome impossible to determine because patient has moved and cannot be traced.

CASE II.—*Primary musculospiral paralysis*. Fracture of surgical neck of humerus and through lower epiphyseal cartilage. Branch to supinator longus and extensor carpi radialis longior affected. Return of motion two months after injury. Complete spontaneous recovery.

CASE III.—*Left musculospiral paralysis*. Comminuted fracture of left humerus. Fracture plated. Date of onset of paralysis not definitely known, but probably a secondary paralysis. Nerve found adherent to bone at site of fracture and kinked. Surrounded by delicate adhesions. Muscle neurolysis. Complete recovery of motor power in six months. Small area of anæsthesia over dorsal web between thumb and index finger. Operation eight months after development of paralysis.

CASE IV.—*Primary paralysis of musculospiral nerve*, the paralysis persisting because the nerve is stretched over the lower end of the upper fragment of a spiral fracture occurring near the middle of the shaft of the humerus. Operation: Muscle neurolysis. No gross change in the nerve, although embedded in some rather delicate scar tissue at the site of the fracture. Not enough time has elapsed since operation, to permit of any return of function.

CASE V.—*Secondary paralysis of left musculospiral nerve*. Fracture junction of middle and lower third. Fracture compound—osteomyelitis with sequestrum formation. Wrist-drop developing fifteen weeks after insertion of intramedullary

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## NERVE INJURIES AND FRACTURES

peg for non-union. Scar and callus inclusion cause of paralysis for paralysis was first noted when callus began to develop posteriorly.

CASE VI.—*Primary musculospiral paralysis.* Fracture of right humerus; transverse lower third; displacement outward of lower fragment. Nerve identified at time of operation for reduction of the fracture. Spontaneous recovery after six weeks.

CASE VII.—*Secondary musculospiral paralysis.* Wrist-drop not observed until several weeks after injury. Spontaneous recovery of paralysis.

CASE VIII.—*Right musculospiral paralysis,* first noted some time after accident. Nerve was, however, divided in antecubital fossa. Operation nine months after injury. Recovery after end-to-end suture. First signs of recovery six months after operation. Return of motion progressing rapidly.

CASE IX.—*Primary paralysis of musculospiral and median nerves left arm.* Injured by falling timber. Fracture of lower third of humerus. Branch to the supinator longus and extensor carpi radialis longior not affected. Musculospiral nerve found divided in antecubital fossa. End-to-end suture almost four years after the accident. Median nerve subsequently explored and found to be considerably thickened just above elbow and imbedded in a scar. Neurolysis.

CASE X.—*Primary paralysis of musculospiral nerve.* Fracture at junction of lower and middle third of humerus. Debridement of wound in treating fracture. Nerve found to be crushed. Death seventy-one days after injury from other wounds. Nerve found embedded in considerable scar and callus at that time.

CASE XI.—*Primary musculospiral paralysis.* Fracture of right humerus in lower third. Repeated operation for repair of fracture which finally united. Operation subsequently upon musculospiral which according to father's statement was not divided. Operation almost four years after accident. Musculospiral not divided; embedded in scar. Neurolysis—no improvement to date.

CASE XII.—*Paralysis of left musculospiral and ulnar nerves* following attempts at reduction of supracondylar fracture. Considerable manipulation required to reduce fracture. Shortly after manipulation paralysis was noted. Complete recovery five months after the reduction.

CASE XIII.—*Primary paralysis of left musculospiral nerve.* Supracondylar fracture with marked displacement forward and outward of lower end of upper fragment. Operation fifty-nine days after injury. Musculospiral nerve not divided. Thickened at site of fracture and adherent to underlying bone. Neurolysis. Examined two months after operation. Marked improvement in the paralysis.

CASE XIV.—*Primary right median nerve paralysis.* Separation of lower epiphysis with marked anterior displacement of lower end of upper fragment. Nerve surrounded by scar enlarged and indurated. Funiculi found passing through indurated portion. Multiple longitudinal incision of nerve. Muscle neurolysis. Eighty-five per cent. recovery.

CASE XV.—*Complete division of right median nerve* associated with supracondylar fracture of the shaft of the humerus. At operation the distal end of the proximal segment of the median nerve was found drawn in between the bone fragments. The nerve was freed and an end-to-end suture performed, with forearm in acute flexion.

CASE XVI.—*Contusion of left median nerve* associated with T-fracture of humerus. Pain noted over the distribution of median nerve immediately after the injury. Symptoms associated with the nerve injury at the present time are pain over distribution of the median nerve in the hand and tenderness. Atrophy is slight and might be accounted for by disuse and immobilization. Median nerve distinctly thickened for a distance of one and one-half inches at the site of the fracture. Spontaneous recovery is occurring.

CASE XVII.—*Late paralysis of median nerve*, sequel to reversed Colles' fracture of right wrist, with permanent anterior displacement of lower fragment. First symptoms of paralysis noticed eighteen years after the injury. Condition persisted until death, five years later, at age of fifty-five years.

CASE XVIII.—*Combined median and ulnar nerve palsy* sequel to oblique fracture of the upper end of left humerus, involving part of the epiphysis. Operation revealed ulnar nerve displaced and embedded in dense scar at the level of the healed fracture. Median nerve twisted  $180^{\circ}$ . Necessary to divide the ulnar nerve to free it from its scar involvement. End-to-end suture made. Median nerve readily replaced in normal position. No later inspection by surgeon, but letter from patient states great improvement in the muscles supplied by the nerve directly involved.

CASE XIX.—*Injury to ulnar nerve*, associated with fracture of the right radius in its lower fourth, with fracture of the styloid process of the ulna and dislocation of the head of the ulna. Three years after injury ulnar nerve exposed by incision just above wrist. Nerve found to have been caught behind the head of the ulna and carried out to the back of the wrist. Two of its funiculi were intact. To free the nerve a partial resection of it was resorted to. End-to-end suture made. Examination two and a half years after operation shows considerable atrophy of the muscles supplied by the ulnar nerve. There is considerable power of adduction and abduction of the fingers. Sensation is practically restored over the area of distribution of the ulnar nerve. There has been considerable improvement in the muscles of the hand since the suture. There is very little if any disability.

CASE XX.—*Division of the right ulnar nerve just above the wrist*, the nerve being divided by the lower end of the upper fragment of the radius which was driven through the soft tissues of the anterior surface of the forearm. Infection with sequestration of the lower part of the radius. Removal of sequestrum with immediate insertion of bone transplant in infected field. Rapid healing with growth of transplant. Secondary nerve suture eight months after accident, with but little return of function, but no great disability.

CASE XXI.—*Ulnar nerve paralysis*, late sequel to fracture at elbow-joint when a boy of seven years. A cubitus valgus remained as the result of the injury. Twenty-two years later, tingling and numbness along the distribution of the ulnar nerve developed, with progressive atrophy of interossei muscles and of the hypothenar eminence. Three years later he presented all the classical signs of ulnar nerve paralysis. The ulnar nerve was then exposed behind the internal epicondyle of the humerus and found flattened as result of its displacement from its normal groove and its long-continued stretching over the epicondyle. The groove was very shallow. The nerve was freed and placed in a groove made by chiselling out a wedge-shaped piece of bone after the periosteum was reflected. The tissues were then sutured over the nerve to prevent displacement again.

This patient was examined April 18, 1922. There has been practically a complete restoration of the function of the muscles of the hand. Patient uses it as well as the other, but it tires somewhat more easily.

CASE XXII.—*Late ulnar nerve paralysis* following fracture of the external condyle of the humerus, the symptoms beginning twenty-three years after the injury. At the age of seven this patient fell and injured his left elbow. He recovered from this injury and had no further trouble until he was thirty years of age, when the signs of ulnar nerve paralysis began to develop, finally exhibiting all the signs and symptoms of ulnar nerve palsy. An X-ray revealed an ununited fracture of the external condyle, two fragments being placed anteriorly. No operation was performed and the symptoms persisted until the patient's death.

## NERVE INJURIES AND FRACTURES

CASE XXIII.—*Late ulnar paralysis* developing thirty-five years after a fracture of the external condyle of the humerus, which remained ununited with development of marked cubitus valgus. After two and a half years persistence of the ulnar symptoms, the nerve was exposed and found to be the seat of a fusiform enlargement, and to be adherent to the surrounding structures. The nerve was freed and the sheath incised.

An examination made April 5, 1922 (three years after operation) reveals a typical ulnar nerve paralysis. The patient states that about one year after the operation the pain commenced to subside and that at present he is free from discomfort. There is a tingling sensation along the little finger when touched, but the sensation along the ring finger has returned to normal.

CASE XXIV.—*Late ulnar paralysis*, sequel to fracture involving the left elbow, injury sustained when four years of age. Recovered with deformity. At age of eight years signs of ulnar defect developed by attempt at violin playing. These symptoms still persist, with marked underdevelopment of the left hand, both in size and muscular power, and vascular supply. Patient avers that the hand is growing gradually worse. It tires more easily, and the times when it becomes numb and painful are more frequent and longer. Operation advised but not accepted.

CASE XXV.—*Late ulnar paralysis*, sequel to a compound fracture of the lower end of the humerus. Injury sustained when ten years of age. Marked gun-stock deformity remains. No nerve symptoms until he was thirty-three years of age, when, after prolonged work in dissecting room, he began to suffer pain in the area of distribution of the ulnar nerve. At the present time there is partial anæsthesia and loss of sensation over the ulnar side of the hand, little finger and exactly one-half of the ring finger. Delicate touch is more acute. The motor power of the muscles supplied by the ulnar nerve is, according to the patient's statement, almost unimpaired. The adductor pollicis and the interossei muscles are atrophied. When palpated behind the internal epicondyle the ulnar nerve is found to be thickened.

An X-ray taken in March, 1920, reveals an old fracture which involves the capitellum and the trochlea. Both condyles appear to be ununited. Two small fragments are found in the region of the olecranon process.

CASE XXVI.—*Paralysis of external popliteal nerve*, complicating fracture of the rim of the acetabulum and posterior dislocation of the head of the femur.

Immediately after the injury the patient noted numbness of the foot and leg and inability to flex the foot dorsalward and to extend the toes. He states that four weeks after the injury he regained power over the toes. While the anæsthesia over the outer side of the leg and the foot has decreased, there is still a very definite and rather extensive anæsthesia and a foot-drop. There is a very decided atrophy of the muscles in the leg.

An X-ray made when the patient entered the hospital revealed a fracture of the rim of the acetabulum above and posteriorly and a fracture-dislocation of the head of the femur.

At operation performed eight months after the injury, the hip-joint was exposed by a posterior incision and the sciatic nerve was first exposed just below the piriformis muscle and a considerable distance of it examined. It presented no evidence of an injury, was not included in callus or hooked over the neck of the femur. The head of the femur was reduced after the new bone in the acetabulum, which had formed in the repair of the fracture, had been removed.

No definite improvement of the anæsthesia or paralysis has been noted up to the present time. Not enough time has elapsed to permit of much improvement.

CASE XXVII.—*Injury of external popliteal nerve*, complicating compound fracture of the leg. The fracture received prompt hospital care. When the plaster cast was removed it was found that the toes could not be extended and that a foot-drop was present. The fracture united in normal time and the patient was discharged from the hospital at the end of three months. At the time of discharge the paralysis was still present, no improvement having occurred. Tingling sensations were felt over the front of both the leg and foot.

CASE XXVIII.—*Injury of external popliteal nerve*, complicating compound epiphysal fracture at lower end of femur. Seventeen months after the injury, the boy was admitted to hospital, presenting all the signs and symptoms of a paralysis of the external popliteal nerve. An incision made over the course of the external popliteal nerve revealed the nerve to be embedded in scar tissue for a distance of three cm. The two segments of the nerve were connected by a strand of connective tissue, which contained apparently no funiculi. The nerve ends were resected until healthy funiculi were exposed and an end-to-end suture was then performed. This suture could be easily made.

A letter received six years later states that there has been no improvement in the muscles supplied by the external popliteal nerve.

CASE XXIX.—*Injury to lumbosacral cord* associated with fracture of the pelvis. The injury was attended with severe pain, radiating into both lower extremities, but especially into the left. This pain was very severe and lasted with gradually lessening intensity for over four weeks. No motor paralysis. Pelvis fractured in five places. Bladder drained.

A search of surgical literature has contributed reports of 210 additional cases of nerve injuries associated with fractures. Abstracts of these cases are included in this paper or published in the Transactions of the American Surgical Association. An analysis only of the features brought out in their study is now presented.

#### BONES FRACTURED WITH ASSOCIATED NERVE INJURIES

Humerus .....	210	Pelvis .....	2
Radius and ulna .....	14	Ulna .....	1
Radius .....	9	Tibia .....	1
Clavicle .....	7	Fibula .....	1
Femur .....	5		—
Tibia and fibula .....	3	Total number of fractures..	253

Some of the fractures were multiple, but one nerve injury complicating these.

Of these 253 fractures the majority were simple fractures, the nerve injury being the direct result of the fracture and not one due to the direct action of the vulnerating force upon the nerve.

Type of fracture: Simple, 180; compound, 38; type not recorded, 35. Total, 253.

The following table indicates the location of the fracture associated most frequently with nerve injury: Humerus, 210; lower third, 113 (53.8 per cent.); supracondylar, 41; shaft, 25; external condyle, 25; internal condyle, 16; separation of epiphysis, 6. Middle third, 52 (27.4 per cent.); upper third, 9 (4.2 per cent.); level not recorded, 36.



Bones of forearm, 24. Upper third, 7 (29.15 per cent.); lower third, 5; middle third, 1; level not recorded, 11.

Femur, 5. Lower third, 4 (80 per cent.); upper third, 1.

Bones of leg, 5. Upper third, 3; level not recorded, 2.

The relation between the nerve injured and the location of the fracture is indicated by the following:

*Musculospiral nerve injury*, 136. Humerus: Middle third fracture, 50 (36 per cent.); lower third fracture, 44 (32 per cent.); supracondylar, 22; shaft, 19; separation of epiphysis, 2; intra-articular, 1; upper third fracture, 7 (5 per cent.); level not recorded, 35.

*Ulnar nerve injuries*, 62. Humerus: Lower third fracture, 55 (88.7 per cent.); external condyle, 24; internal condyle, 10; supracondylar, 7; separation of epiphysis, 3; both external and internal condyles, 3; position not recorded, 8.

Radius upper third, 2; both bones of forearm, 2; ulna—middle third, 1; ulna—lower third, 1.

*Median nerve injuries*, 15. Humerus—lower third, 11 (73.3 per cent.); radius—upper third, 2; radius—lower third, 2.

*Brachial plexus injuries*, 7. Clavicle, 6 (85 per cent.); humerus—upper third, 1.

*External popliteal injuries*, 8. Femur, 4; fibula, upper third, 2; tibia, upper third, 1; both bones of leg, 1.

*Median and ulnar nerve injuries*, 2. Both fractures of humerus, middle third.

*Radial and ulnar nerve injuries*, 1. Supracondylar fracture of humerus.

*Radial, median and ulnar nerve injuries*, 1. Supracondylar fracture of humerus.

*Sacral plexus injury*, 1. Fracture of pelvis in region of sacro-iliac joint.

*Anterior crural injury*, 1. Fracture of femur—upper third.

*Sciatic injury*, 1. Fracture of rim of acetabulum posteriorly.

*Anterior tibial injury*, 1. Fracture of both bones of leg—upper third.

*Musculocutaneous of leg*, 1. Fracture of both bones of leg—upper third.

It has been customary to divide the nerve injuries associated with fractures into the primary and secondary. In the primary the symptoms associated with the injury occur at the time of the fracture or very soon after, while in the secondary the symptoms develop some time after the fracture occurred and may develop slowly. In some of the cases which we have seen, it has been impossible to determine from the history which could be elicited when the symptoms associated with the nerve injury developed, for the symptoms which undoubtedly had been present in many cases from the time of the injury were noted when the dressing was changed some days later. The necessity of more complete examinations of fractures must be emphasized, for complicating lesions are often overlooked and facts which are of importance in determining the prognosis and treatment to be employed are not elicited.

Of the 239 cases analyzed by us, the following figures indicate the relative frequency of the onset of the paralysis: Primary, 60 (25.1 per cent.); secondary, 99 (41.4 per cent.); late, 52 (21.7 per cent.); not recorded, 28.

The probabilities are that many of the so-called secondary paralyses should be grouped with the primary, the paralysis having not been discovered when the first examination was made, but being noted when the case or dressing was changed later. Statistics dealing with the time of onset of the paralysis will, as stated above, be inaccurate until more careful examination of fractures is made, the possibility of nerve and vessel injuries being kept in mind.

The following table indicates the nerves involved in the primary injuries, the treatment employed, the pathological changes in the injured nerve and the end-results.

*Primary Paralyses—Sixty Cases*

(a) Nerves involved: Musculospiral, 44 (73.3 per cent.); ulnar, 5; external popliteal, 3; median, 3; radial and ulnar, 1; radial and median, 1; median and ulnar, 1; sciatic, 1; sacral plexus, 1. Total, 60.

(b) Treatment: Cases operated upon, 38 (63 per cent.); cases not operated upon, 16 (28 per cent.); amputations, 1.

(c) Pathologic findings in cases operated upon: Anatomic division of affected nerve—radial, 13; median, 2; ulnar, 2 (28.3 per cent.).

Six in middle third of humerus; four in lower third of humerus; one in upper third of humerus; four location not recorded.

Nerve caught by end of displaced fragment of bone, 14 (23.3 per cent.); nerve interposed between the fragments, 6; nerve embedded in scar and callus, 1.

(d) End results in relation to the treatment: 16 cases not operated upon; completely recovered, 12 (75 per cent.); partially recovered, 2; result not recorded, 2.

Thirty-six cases operated upon: 23 operated upon within six months—completely recovered, 16 (66 per cent.); partially recovered, 4; end-result not recorded, 3.

Three operated upon between six months and one year. Completely recovered, 2; partially recovered, 1.

One operated upon between one and two years. Completely recovered, 1.

One operated upon between two and three years. Completely recovered, 1.

Four operated upon three years after injury. Partially recovered, 1; not improved, 3.

Four cases in which interval between operation and injury was not recorded. Completely recovered, 1; partially recovered, 3.

(e) Type of operation: Of the 36 cases operated upon neurolysis was performed in 24 (66⅔ per cent.) and end-to-end suture of the divided nerve in 12 cases (33⅓ per cent.). Resection of the humerus was performed in 5 of these 12 cases in order that the ends of the nerve could be approximated.

## NERVE INJURIES AND FRACTURES

The following data was found in the analysis of ninety-nine cases of secondary paralysis:

(a) Nerves involved: Musculospiral, 69 (69 per cent.); median, 11; ulnar, 7; brachial plexus, 6; external popliteal, 3; radial and median, 1; radial, median and ulnar, 1; anterior tibial and musculocutaneous, 1. Total, 99.

(b) Time paralysis was first observed: After removal of the splint, 28 (28 per cent.); during course of bone repair, 59 (59 per cent.); after union of the fracture, 12.

In two cases where the paralysis was noted after removal of the splint the nerve was found at operation to be anatomically divided.

(c) Treatment: Operated, 83 (83 per cent.); not operated, 16. Total, 99.

(d) Pathological findings in the cases operated upon: Nerve caught over end of displaced fragment, 34 (40 per cent.); nerve embedded in scar and callus, 31 (37 per cent.); nerve interposed between bone fragments, 7 (8 per cent.); nerve embedded in a bony tunnel, 7; pseudo-arthritis present, 6; nerve anatomically divided, 3; bone splinter lodged within the nerve, 1.

(e) Character of the operations: Neurolysis performed, 74 cases (89 per cent.); end-to-end suture of nerve, 8 cases (10 per cent.).

Resection of a portion of the humerus was necessary in two cases before the nerve ends could be brought together.

In one case the sciatic nerve of a dog was used to bridge a wide gap.

(f) End-result in relation to treatment: Sixteen cases *not* operated; completely recovered, 6 (37 per cent.); partially recovered, 1; result not recorded, 9.

Eighty-three cases operated. Fifty-seven operated within six months. Completely recovered, 46 (80 per cent.); partially recovered, 8; not improved, 1; result not recorded, 2.

Three operated between six months and one year. All partially recovered.

Eight operated between one year and two years. Completely recovered, 2; partially recovered, 2; not improved, 3; result not recorded, 1.

Two operated three and a half years after injury. Both completely recovered.

Then thirteen cases in which the record of the interval and the end-result were lacking.

By far the greater majority of the late paralysis are those associated with fractures about the lower end of the humerus, a paralysis of the ulnar nerve developing years after the injury, when the nerve is frequently traumatized as the result of stretching because of a cubitus valgus or because of the development of bony excrescences.

Late paralyses, 52 cases. (a) Nerves involved: Ulnar, 49 (94 per cent.); median, 2; median and ulnar, 1. Total, 52.

(b) Time of onset of the paralysis: The interval between the injury and onset of symptoms ranged between two and thirty-nine years. Interval under ten years, 7 (13 per cent.); interval between ten years and twenty years, 10 (20 per cent.); interval between twenty years and thirty years, 21 (40 per

cent.); interval between thirty years and forty years, 8 (15 per cent.); recorded as "many years," 6. Total, 52.

(c) Location of the fractures: Ulnar paralysis, 49 (all lower third of humerus); external condyle, 23 (47 per cent.); internal condyle, 10 (20 per cent.); supracondylar, 8 (16 per cent.); separation of epiphysis, 2 (4 per cent.); level not recorded, 6.

Median paralysis, 2; radius (upper third), 1; radius (lower third), 1.

Median and ulnar paralysis, 1; radius (upper end) and internal condyle of humerus.

(d) Treatment and end-results:

	Recovery		Not Improved	No Record
	Complete	Partial		
13 cases not operated .....		4	3	6
28 cases operated				
17 type of operation not recorded .....		11		6
6 neurolysis .....		2	2	2
2 cubitus valgus corrected by osteotomy....	1	1		
1 cystic bone tumor removed from ulnar groove .....	1			
1 new groove for nerve chiseled out.....	1			
1 end-to-end suture of nerve .....	1			
	4	18	5	14

11 cases no record as to treatment or result

The results of the examination of the data which have been found in the literature and afforded by our cases may be shortly summarized as follows:

1. Eighty-eight per cent. of fractures associated with nerve's injury are of the *humerus*.

2. Fifty-three per cent. of fractures of the humerus are of the *lower* third. Twenty-five per cent. of fractures of the humerus are of the *middle* third.

3. Of the nerves involved in fractures: 57.6 per cent. are musculospiral; 25.4 per cent. ulnar; 5.5 per cent. median.

4. Thirty-six per cent. of *musculospiral* injuries are fractures of the *middle third* of the humerus. Thirty-two per cent. of *musculospiral* injuries are fractures of the *lower third* of the humerus.

5. Ninety per cent. of *ulnar* nerve injuries are fractures of the lower third of humerus.

6. Seventy-five per cent. of *median* nerve injuries are fractures of the lower third of humerus.

7. Twenty-four per cent. of *nerve injuries* associated with fractures are *primary* paralyses. Forty-two per cent. of *nerve injuries* associated with fractures are *secondary* paralyses. Twenty-two per cent. of *nerve injuries* associated with fractures are *late* paralyses.

8. *Primary paralysis*: Seventy-seven per cent. were of the musculospiral nerve. Sixty-three per cent. of these were operated upon, twenty-eight per cent were not. Neurolysis was performed in 66⅔ per cent. of the cases operated upon and end-to-end suture in 33⅓ per cent. Forty-one per cent.

of the cases operated upon had anatomic division of the nerve. In forty-one per cent. of the cases operated upon the nerve was caught over displaced fragments. In twenty-five per cent. of the cases the nerve was interposed between fragments. Of those operated upon within six months after the fracture 70 per cent. completely recovered.

9. *Secondary paralysis*: Sixty-nine per cent. were of the musculospiral nerve. Twenty-eight per cent. were first noticed after removal of the splint. Fifty-nine per cent. were first noted during repair of the fracture. Twelve per cent. were first noticed after the fracture had united. Eighty-three per cent. of the cases were operated upon; sixteen per cent. were not. Neurolysis was performed in 89 per cent. of the cases operated upon; end-to-end suture in 10 per cent. In 40 per cent. of the cases operated upon the nerve was caught over displaced fragments. In thirty-seven per cent. of the cases the nerve was buried in scar and callus. In eight per cent. of the cases operated upon the nerve was interposed between fragments. Of those not operated upon, thirty-seven completely recovered. Of those operated upon within six months after the fracture 80 per cent. completely recovered.

10. *Late paralysis*: Ninety-four per cent. were of the ulnar nerve. In forty per cent. the onset was between twenty years and thirty years after injury. In twenty per cent. the onset was between ten years and twenty years after injury. In fifteen per cent. the onset was between thirty years and forty years after injury. In forty-seven per cent. of the cases ulnar paralysis were due to fractures of *external condyle* of humerus. In fifty-three per cent. of the cases ulnar paralysis had a marked *cubitus valgus*.

11. In the entire series of 236 cases: End-to-end suture of the nerve was done in twenty-two cases. Seven of these required resection of a portion of the humerus before the nerve ends could be brought together. Of these twenty-two cases there were fifteen complete recoveries.

It seems that the following conclusions may be drawn:

1. Nerve injuries are associated with fractures much more frequently than supposed. They are frequently overlooked because of the hasty and incomplete examination of fractures. When fractures are examined the possibility of a nerve injury should always be kept in mind.

2. The character of the injury varies greatly, from the slightest contusion from which the patient rapidly recovers, to anatomic division and callus inclusion which demand surgical interference.

3. It is often impossible to differentiate by the most careful neurological examination between physiologic interruption of the nerve current and anatomic division of the nerve.

4. There is a tendency in these cases to wait too long for spontaneous recovery.

5. When recovery has not commenced within three months after the injury, the injured nerve should be explored and the surgical procedures demanded by the pathological findings be instituted.

6. Neurolysis is the operation which will be most frequently required.

Resection of the humerus should no longer be resorted to to permit of end-to-end suture of the musculospiral nerve. Tendon transplantation should be performed in these cases.

7. The prognosis is very favorable in injuries of this type because of the frequency with which the musculospiral nerve is the one injured and because of the relative infrequency with which it is divided, only neurolysis being necessary.

8. In the late ulnar nerve palsies, transposition of the nerve to the front of the elbow will be necessary in the cases of cubitus valgus. When bony outgrowths cause the paralysis, removal of such outgrowths and the placing of the nerve in a healthy bed may be all that is required.

## BONE FORMATION IN OPERATIVE WOUND CICATRICES

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THE following case I do not consider as belonging to that class of traumatic muscle ossification so commonly met with by the surgeon, known as "riding bones" in the thighs of cavalrymen, "exercise bones" in infantrymen, etc., where there seems to be a predisposition to bone formation analogous to keloid in some races. I have removed several of these bones, especially from the deltoid and quadriceps. In 1914 Fay<sup>1</sup> reviewed this phase of the subject very thoroughly, and stated that at that time over five hundred reports of muscle ossification had been made. He discusses four etiological theories: (1) The hæmic; (2) the aberrant sesamoid bones; (3) periosteal origin; (4) ossifying myositis, and remarks that the theory of periosteal dissemination, of periosteal flap detachment, of ossifying myositis in the sense of an inflammatory process due to infection or chemical irritation, are alike unconvincing, while on the other hand, the marked resemblance to the callus of fractures suggests a reparative process. He reports six cases of intramuscular ossification and concludes that it is impossible to study the subject until we are able to reproduce these bones.

Capelle,<sup>2</sup> in 1911, reports *two new cases*, one in a workman of thirty-four years, the other in a merchant of sixty-three years, in which bony formation occurred in laparotomy wounds. Operation for gastric ulcer had been performed in both cases and silk was used for suturing. In both cases the intra-abdominal portion of the operation was uncomplicated. The second patient was difficult to close on account of tense abdominal muscles. The surface wounds in both cases healed by primary intention, but there were later complications in both scars.

In Case I, a second laparotomy through the first incision was done and no peculiarities were noted in the cicatricial tissue.

In Case II, the silk suturing broke on the ninth day, with dehiscence of the rectus, and a fistula resulted in the abdominal muscles, but the final formation of cicatricial suturing did not occur under septic conditions.

The relaparotomy wound in Case I healed uneventfully, but the fresh scar was subjected to exertion by the symptoms attending an abscess of the lungs, which ended fatally after four weeks. The necropsy showed a septic endocarditis, so that a hamatogenous infection of the scar was possible in this case also.

In Case I, the bony formation, found at the necropsy four weeks after the original operation, was seven centimetres long and four centimetres wide. Its length corresponded exactly to the old laparotomy scar. Its development had not been watched clinically.

In Case II, the formation was noted step by step. After formation of the fistula in the hernial operative scar, a slight succulence of the right border of the rectus appeared. In the first weeks there was not much change. In the seventh and eighth weeks the infiltration hardened and extended vaguely in the direction of the muscular substance. In the ninth and tenth weeks, the entire swelling

assumed a definite form, with outline clearly defined in the direction of the muscular substance. By the end of the tenth week, development had reached its limit and gradual hardening followed. After eleven weeks a slightly curved body, from seven to eight centimetres long and two centimetres broad, was sharply set off from the soft parts. The diagnosis was confirmed twelve weeks after operation, when a specimen was chiseled from the centre of the bone.

Histologic control showed direct transition of connective tissue into bone and cartilage in both cases.

Operative trauma, as such, suturing trauma, aggravated mechanical demands on the fresh scars, and injury from infection are all possible factors in the etiology. Participation of the periosteum as an etiological factor is out of the question in the given cases. The writer suggests the possibility of a peculiar disposition of the linea alba to bony formation. Embryonic cells with atavic tendencies may occur.

Hannes<sup>\*</sup> in 1911 discovered a hardened growth in the cicatricial tissue of a hernial scar in a woman of sixty-one. Histologic examination identified the structure as bone. The cases of Rubesch, Roepke, and Legene are quoted. In addition to these three, only one other case could be found in literature: Sabijaquina (1910) removed from a laparotomy wound, two and one-half months after operation, a piece of bone one by one and one-half centimetres. Histologic investigation showed that it had been formed in part directly from connective tissue and in part with an intervening stage of cartilage formation. Hannes considers the traumatic theory improbable and attributes these growths to a tendency to abnormal ossification.

In all five cases the bone merged with surrounding cicatricial tissue. Although Roepke's case seems to show that the ossification extended into the musculature, the growth had not formed in an otherwise normal muscle, as occurs in circumscribed traumatic myositis ossificans. In each case the bone was embedded in the scar, not in the muscle.

Legene<sup>\*</sup> in 1909 reports a case in which eight months after a median incision for gastric ulcer a nodule, the size of a hazelnut, was found in the upper portion of the scar. The patient was again examined two years later and the operative wound was clearly distended. There was a hernia, and a hard growth could be felt at the superior border of the neck of the sac. Operation was performed; the ossification showed the form of half a key-ring, terminating at each side in a tapering extremity which merged into the sheath of the rectus muscle. It was completely enclosed by cicatricial tissue. Histologic examination identified the growth as bone.

The writer then experimented with muscular trauma in five guinea-pigs. Several days after injury one or two cubic centimetres of aqueous solution of phosphate acid of lime was injected around the foci of the contusions, and examination made nine weeks later. Connective tissue resulted, but there was no trace of calcification or ossification. He is inclined to believe that the explanation of this phenomenon should be sought in a general modification in the metabolism of lime salts, rather than in a local modification of the tissues.

Roepke<sup>\*</sup> in 1907 reports two cases. Case I, a man, aged forty years, was operated for perforating gastric ulcer. The wound was closed with catgut and healed by primary intention. Another operation five weeks later, through the same wound, showed thick bony tissue, two centimetres long and one centimetre thick, in the rectus muscle.

Case II, a man, age thirty years, was operated twice, once for appendicitis, with right rectus incision, and again for adhesions, with midline incision. Silk





FIG. 1.—Bony new growth in scar of operation for inguinal hernia.

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was used for the skin. One year after last operation, another midline incision revealed a pair of thin, bony plates, embedded in the scar. The larger was about two centimetres in diameter.

Roepeke reasons that if bruised tissue is not absorbed, a deposit of lime could occur and ossification result. Operation, as such, and also the suturing could constitute the etiologic factors in the trauma.

Rubesch<sup>9</sup> reports the case of a man, age forty-three, in which seven days after operation for liparocele a small hæmatoma appeared in the operative wound. Twelve days later the operative wound was healed. Five months later a hard knot was found in the scar, and removed. The specimen was a flat oval, three and five-tenths centimetres long, one and five-tenths centimetres wide, and about five-tenths centimetre thick. The histologic examination showed it to be composed of coarsely fibered osseous tissue. The cicatricial tissue clearly furnished the matrix for the growth. In places, transitional stages between connective tissue and bony tissue occurred.

He states that it is not probable that the earlier hæmatoma played a rôle in the formation of the bony growth, since all traces of it had disappeared when patient was discharged; but the man was a grave-digger, and it is possible that the suturing, combined with constant bending, produced trauma. In any case, abnormal tendency must be taken into consideration as an etiologic factor.

In the case here reported there was no history of infection. The new bone was not connected with muscle in any way, but lay in the scar tissue just above the shelving portion of Poupart's ligament, and was movable. It was not attached to the pubic bone. It was easily separated from the connective tissue which extended through the little holes in the specimen. Fine, sharp spicules, or finger-like projections, reached out into the scar, but were not a part of it. Histologic examination showed the specimen to be true bone. No cartilage or connective cells were found. The bone was difficult to decalcify. It is my opinion that in taking the lowest suture to pull the internal oblique and transversalis over to where Poupart's ligament joins the pubic bone, the operator pricked the bone with his needle and carried some osteogenic cells into the wound, where they proliferated the same as the new connective-tissue cells did which formed the new scar in the reparative process. The condition suggests the possibility of growing osseous tissue outside the body.

*Case Report* (R. E. F., No. 12486).—American, white male, married, age thirty. Chief complaint is pain in right groin, especially after walking or bending forward. He states that in April, 1919, he injured his right side by jumping. In June, 1920, a right herniotomy was done and he was in bed sixteen days. Wound healed by primary intention. In November, 1920, he first noticed a tumor under the scar; it was painful and was movable.

Examination showed a thirteen-centimetre scar above and parallel with Poupart's ligament, also a hard, irregular tumor mass in the scar, about eight centimetres long and two and two-thirds centimetres wide, movable and tender to pressure. The right testicle was found atrophic. There were no signs of a recurrence of the hernia. The external abdominal ring was very small. The X-ray revealed a hazy, irregular, opaque mass anterior to and extending about one and one-third centimetres above the right horizontal ramus of the pubic bone. It presented the appearance of a partially calcified cartilaginous mass near the lateral extremity of the body of the pubic bone.

On October 20, 1921, the foreign body was removed from the right inguinal region. An incision was made above and parallel with Poupart's ligament, below the scar of the former operation, through skin, superficial fascia, and external oblique aponeurosis. The tumor was removed by blunt dissection and wound closed.

Pathology (Gross): Foreign body proved to be new osseous growth, about five centimetres square, irregular in outline, having many sharp projections (Fig. 1). It is the opinion of the operator that at the former operation the needle struck the pubic bone and carried a few osteogenic cells into the soft tissues; these found a good culture medium, perhaps in a blood clot, and thus the new growth was formed in the scar tissue of the herniotomy wound. Microscopically the specimen proved to be true bone.

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## INTUSSUSCEPTION OF STOMA FOLLOWING GASTRO-ENTEROSTOMY

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POST-OPERATIVE mechanical complications following a gastro-enterostomy are very rare at the present time. Formerly vicious circle followed gastro-enterostomy rather frequently. However, since the introduction of the no-loop posterior gastro-enterostomy vicious circle has become a historic curiosity. Nowadays the most frequent cause for vicious circle following gastro-enterostomy is the formation of kinks or bands at or around the efferent loop, thus causing regurgitation of gastric contents and bile into the stomach. If properly recognized this mechanical impediment to the outflow of gastric contents can be easily dealt with by secondary operation.

Moschcowitz and Wilensky<sup>1</sup> reported a case of internal hernia following gastro-enterostomy, caused by the entrance of a large portion of the small intestine into the defect in the mesocolon. Similar cases have been reported by Bryan,<sup>2</sup> Mayo and Magoun<sup>3</sup> and others.

Mechanical complications of another type, *i.e.*, intussusception of the efferent loop, have been reported recently by various authors. Steber's<sup>4</sup> patient, twenty-one years old, had a gastro-enterostomy performed one and a half years previously. Two days before admission to the hospital she began to vomit continuously. The vomitus was bloody. She was observed in the hospital for three days without operation. She died on the fourth day.

Post-mortem examination showed that an intussusception had occurred in the efferent loop. The intussusceptum, 30 cm. in length, had travelled upwards through the stoma into the stomach, filling up the stoma. The intussusceptum was gangrenous.

Hartert<sup>5</sup> and Amberger<sup>6</sup> have recently published cases of intussusception of the efferent loop. In both cases the intussusceptum was only about two inches long and did not reach the stoma. The intussusceptum was easily reduced in both cases. The patients made an uneventful recovery.

Baumann<sup>7</sup> has reported a similar case, following gastro-enterostomy and entero-anastomosis. The intussusception was reduced without difficulty. However, it recurred six weeks later. A resection of the affected portion of the intestine cured the patient.

I have recently seen another complication causing a complete obstruction, *i.e.*, intussusception of the newly formed stoma into the stomach.

P. S., fifty-three, was admitted to Beth Israel Hospital March 25, 1920. He complained of epigastric distress for eight years. The pains are sharp and burning in character and occur fifteen minutes to one-half hour p.c. The pains are relieved by soda bicarbonate. There is marked intermission of symptoms. Patient

feels perfectly well for the period of six months, when pains recur. In the last few months his attacks have become more severe and he vomits frequently. He lost about 16 pounds in the last three months.

*Status:* Poorly nourished patient. Marked barrel-shaped chest. Subcrepitant râles at both bases. Systolic murmur at the apex. Abdomen negative, except for slight tenderness on pressure in the right epigastrium.

X-ray examination shows a filling defect in the duodenum and a slight six-hour residue in the stomach.

*Pre-operative diagnosis:* Duodenal ulcer.

*Operation* March 29th (Lewisohn): Median incision between ensiform process and umbilicus. A crater-ulcer, adherent to the head of the pancreas, is present in the second part of the duodenum. A typical posterior suture gastro-enterostomy and pyloric exclusion with a Pagenstecher stitch was performed. Layer suture of abdomen.

March 30th: Patient vomited small amounts of brownish fluid; relieved by gastric lavage.

March 31st: No vomiting. Condition good.

April 1st: Uneventful convalescence.

Patient seemed to make an uneventful recovery when the vomiting recurred on April 4th (six days after the operation). The vomitus was very copious, and occurred every few hours. Repeated lavage during the next two days did not bring any relief. The patient began to lose ground very rapidly. He developed a bronchopneumonia in both lungs with dullness and crepitant râles at both bases. X-ray examination of the chest showed a large area of infiltration at both bases.

The general condition of the patient grew rapidly worse. His freedom from symptoms from the third to the sixth day post-operative and the sudden onset of copious vomiting on the sixth day suggested the possibility of an acute intestinal obstruction (possibly a kink in the efferent loop, just below the stoma).

*Operation* April 6th: Exploration through the same incision. The findings were indeed very remarkable. The obstruction was caused by an intussusception of the whole stoma into the lumen of the stomach (Fig. 1). The intussusception began just below the level of the stoma. The anterior wall presented a distinct fold. The lower two-thirds of the anterior wall of the jejunum (Fig. 1, a) formed the intussusceptum and had disappeared into the lumen of the stomach, where a hard mass, size of strawberry, could be felt through the walls of the stomach. The lower border of the jejunum (Fig. 1, b) had followed the same course into the stomach. After it had passed the stoma, it became œdematous at the site of neck of the stoma and could not slip back automatically into its normal position. Thus there resulted a complete obstruction at the site of the stoma, causing immediate regurgitation of food, gastric juice and bile. The afferent loop was hugely dilated, the efferent loop very much collapsed. The intussusception was easily reduced. The intussusceptum was injected, but not gangrenous. On account of the discrepancy in the sizes of the afferent and efferent loops and in order to safeguard against a recurrence of obstructive symptoms an entero-enterostomy was performed.

The patient stopped vomiting immediately after his second operation. Vomiting did not recur during the subsequent six days of his illness. However, though he took nourishment well, his emaciation progressed. He developed a left parotitis on April 11th. The process in the lungs gradually extended and he died on April 14th.

No post-mortem examination could be obtained.

The intussusception must have occurred on the sixth day after the primary gastro-enterostomy, the same day that the incessant vomiting began. Coincident

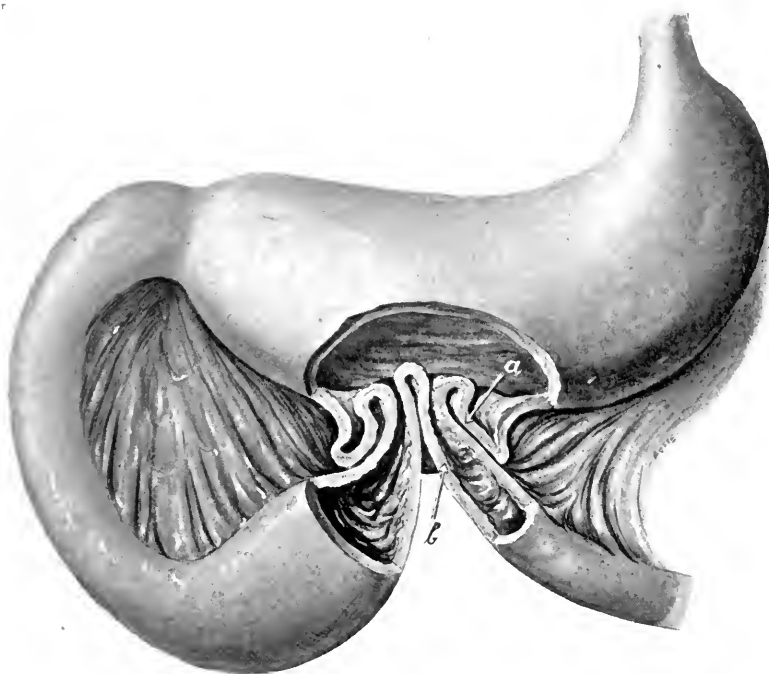


FIG. 1.—Intussusception of gastro-enterostomy stom.





## INTUSSUSCEPTION OF GASTRO-ENTEROSTOMY STOMA

with the vomiting the patient began to lose ground very rapidly, as so often observed after high intestinal obstructions.

It is certainly remarkable that in forty years of gastro-enterostomy a similar case has not been reported. Its extreme rarity seemed to warrant a brief report.

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## CORRESPONDENCE

### EIGHT TOES ON ONE FOOT

EDITOR ANNALS OF SURGERY:

SIR:

THE case herewith reported is of sufficient interest to be placed on record.

The patient, a babe forty days old, of Italian parentage, was referred to our service by Dr. Earnest F. Cox. Child was normal birth, breast fed, in good health; weight and size normal. Examination revealed nothing of interest excepting that there were eight digits on the left foot. This foot was broadened, because of the supernumerary toes, to the tarso-metatarsal junction. There was movement in all toes, but limited somewhat to the three medial digits. The foot, as shown in the photograph (Fig. 1), has, beginning medially, a great toe, then a corresponding second and third toe, the size one would expect to find with this great toe. Laterally from this we find five digits, normal in size and arrangement. We also note in the radiogram that all of these digits have a corresponding metatarsal bone, the size being plainly shown.

Centres of ossification for the shaft of metatarsal bones appear about the fourth month, *in utero*. Here we note that ossification is well advanced. The epiphyses, however, do not show because of the age. They usually begin ossifying in the third year of life. The phalanges are all well formed, their ossification beginning the third foetal month. Ossification in the epiphyses is not shown, this occurring at a later period. The os calcis and cuboid show ossification. The cuboid is the only small tarsal bone which ossifies before or at time of birth. The scaphoid and cuneiform bones at this period show no ossification. It will be further noted that there is a disproportion in length of the fibula and tibia of left leg with a change in their normal supero-inferior relation or position. The fibula is apparently displaced upward and is longer than the tibia.

Normal anatomy shows that the malleolus of the fibula extends one-fourth of an inch lower than the malleolus of the tibia, but the tibia extends about one-fourth of an inch above the fibula, this places the epiphyseal line at a corresponding level. The radiogram measurement shows the fibula to be two and five-eighths inches in length, while the tibia is two and three-eighths inches. This difference in length and position places the fibula five-eighths inch nearer.

On August 2, 1921, we removed the three medial toes with their metatarsals. Small tendons were noted to the digits. The wound healed nicely, leaving only a slight irregularity on the inner border of the foot. On May 11, 1922, we examined the foot and had another X-ray taken. The babe wears same size shoe on both feet and shows very little irregularity of inner margin of foot. She walks in her



FIG. 1.—Radiogram showing eight digits on one foot.



walking frame and does not favor the left foot. Function seems to be normal. The radiogram, after operation, shows that the proximal ends of the metatarsal bones project obliquely with slight lateral displacement of the proximal ends of the metatarsal bones. It shows ossification in the tarsal bones which was not present at time of operation.

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## EFFECTS OF SODIUM CITRATE ON BLOOD COAGULATION

EDITOR, ANNALS OF SURGERY:

SIR:

In a paper entitled "Intramuscular Administration of Sodium Citrate" (ANNALS OF SURGERY, 1922, vol. lxxvi p. 1), Neuhof and Hirshfeld state:

"The experiments consisting in the intravenous injections of solutions of sodium citrate were performed on dogs under ether anæsthesia. In brief, they established the following hitherto undescribed results of the administration of sodium citrate: (1) The coagulation time is tremendously shortened within a few minutes of the introduction of non-toxic doses of sodium citrate and this shortened coagulation may be sustained for one or more days," etc.

The fact that sodium citrate, introduced into the blood stream, would shorten the coagulation time considerably, was first noted by the late Doctor Weil in 1914. I quote verbally from his paper ("Sodium Citrate in the Transfusion of Blood," *J. A. M. A.*, 1915, vol. lxiv, p. 425):

"A possible objection is based on the influence of sodium citrate on the coagulation time of the donée. This has been tested for me in a series of cases by Doctor Beck of the General Memorial Hospital. The figures indicate that the introduction of large amounts of 20 per cent. sodium citrate solution do not lower the coagulation time in the least. In fact, five gm. of sodium citrate reduces the coagulation time by one-half. The tests have been made on blood aspirated from the vein immediately before and ten minutes after the injection. It gradually returns to normal."

Weil's dose (five gms.) is practically identical with Neuhof and Hirshfeld's "optimum" dose of six gms., used in the attempt to control hemorrhage.

In a paper entitled "A New and Greatly Simplified Method of Blood Transfusion," *Med. Rec.*, 1915, vol. lxxxvii, p. 141, I reported the following animal experiments:

"The normal blood taken from the carotid artery of the dog before the experiment was started, showed five minutes coagulation time. Three hundred c.c. of blood were then removed from the artery mixed with five c.c. of 10 per cent. sodium citrate solution and then reintroduced into the jugular vein. Three specimens of blood, taken from the carotid artery at intervals of three

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minutes after injection of the blood into the jugular vein, showed that the blood clotted in ten seconds."

In order to show that I was well aware of the fact that this shortening of the coagulation time was due exclusively to the action of sodium citrate. I quote from another paper ("Modern Methods of Blood Transfusion," *Journ. Am. Med. Assoc.*, 1917, vol. lxviii, p. 826):

"How does sodium citrate affect the coagulation time of the blood? The introduction of citrated blood causes a temporary shortening of the coagulation time of the recipient's blood. The coagulation time returns to its previous level in less than twenty-four hours."

It is thus apparent that the temporary shortening of the coagulation time following the intravenous administration of sodium citrate was observed by Weil and myself seven years ago. Neuhof and Hirshfeld's observations confirm these findings. However they do not represent any "hitherto unknown" facts.

On the other hand, the intramuscular administration of sodium citrate in the attempt to control hemorrhage as conceived by Neuhof and Hirshfeld opens an entirely new field. This part of the work, if corroborated by further observations, might represent an important step forward in our treatment of hemorrhage.

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## THE TREATMENT OF CHRONIC EMPYEMA WHERE THE RECOGNIZED SURGICAL PROCEDURES HAVE FAILED TO PRODUCE OBLITERATION

By WILLIAM L. KELLER, M.D.

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WHEN the crest had been reached in the treatment of strictly post-war surgery and the number of this type of case had begun to wane, the Army found itself confronted with a large number of chronic empyema cases, the residue of the well-remembered influenza epidemic of 1917 and 1918. All the time-honored and well-recognized measures of treatment, though applied with consummate skill and untiring patience by many of the ablest surgeons in the country, went unrequited so far as this particular group of unfortunates was concerned, and so we had confronting us then a forlorn lot of surgically scarred individuals who had seen many a bitter day of sorely tried hopes as one operative procedure after another had failed them. The mere conventional valuation of life would have been incentive enough had not the humane element actuated us to attempt some method other than the ones which had already spelled failure. We were fully cognizant of the complex and diverse aspects of the problem, yet our aim was to discover in this great mass of contradictory operative procedures and end results, the reason or reasons for failure. This accomplished, it would then become our duty to effect a cure and at the same time be prepared, if necessary, to controvert opposing opinions. The principal motive in acting then was with this hypothesis in mind, and so we set resolutely to the task, but with a determination not to be tempted into foolhardiness. All the patients in question were poor surgical risks, depleted both in mind and body, and any surgical attempt at repair had to be done, step by step, but never until the full confidence of the patient had been gained.

A previous experience of some seven years ago first led me to believe in the wisdom of the "open type" of operation as both the logical and surgical method to pursue. At that time, I was attempting to do a partial decortication on a patient who had had five previous operations for chronic empyema, when the hemorrhage encountered became so profuse that it was necessary to clamp the bleeding points, leave the clamps in position and pack the remaining cavity. This, of course, was in the pre-Dakin days, but subsequently, I was astonished to see the ease with which the antiseptic solution could be applied directly to every recess of the cavity, the rapidity with

which the cavity became clean, and the promptness with which it was afterwards obliterated. That the obliteration was permanently successful is evidenced by the fact that this patient, an officer, has remained constantly on active duty since the time in question, and in the meanwhile served in France throughout the strenuous days of the World War.

It seemed but logical then that these very same conditions should be simulated in the treatment of the post-influenzal cases of chronic empyema if a very resistant type of organism, the hæmolytic streptococcus, is to be rendered inert and that through the agency of a most valuable adjunct in the treatment of such cases—the Dakin solution—which had been placed in the hands of the surgeon as one of the scientific triumphs of the World War.

From such a beginning as this did the present type of "open operation" then evolve, being elaborated from time to time by the operator as the occasion arose to meet and overcome new conditions and complications.

In this paper I want to deal especially with the cases which have resisted all the well-recognized surgical procedures and have subsequently fallen into my hands for treatment and final disposition. In this connection, I want to enumerate briefly the predominating etiologial factors which have been brought forcibly to my attention in the observation and treatment of such cases. Among their number, 60.8 per cent. presented pleurobronchial fistulæ; 90 per cent. had osteomyelitis of the ribs with or without sequestration; 75 per cent. showed accessory pockets or diverticulæ; 15 per cent. foreign bodies in the nature of rubber tissue, drainage tubes or bismuth paste; 100 per cent. had hæmolytic streptococcus as the causative organism and 15 per cent. had underlying constitutional conditions such as tuberculosis and syphilis.

Our aim therefore is to obliterate these cavities by a method which will produce the minimum mutilation, increase vital capacity and lower mortality. To us the "open" many-stage operation approaches closer to this ideal than any other method that we know.

Inasmuch as the previous methods of operative procedure in the hands of competent surgeons, when the patients were better able to withstand operative trauma and overcome their infections, had failed, it seemed that some operation should be attempted which would obviate these causes for failure in the past, and, at the same time, be well within the limits of safety by minimizing shock.

It was obvious that these patients could not withstand an extensive operation. They presented suppurating cavities, and since resected ribs projecting into such a cavity may or may not go on to osteomyelitis with sequestration, it seemed as though the logical procedure to follow was to lay the cavities completely open for direct Dakinization and visual inspection at all times.

The reason for this open type of operation was made more apparent when it was realized that a large percentage of cases of chronicity and recurrence were due to diverticulæ, unnoticed at the time of operation, draining by minute sinuses into the main cavity, or in some cases to an unobliterated and infective pocket, usually lying anteriorly or posteriorly to the main cavity, which failed to close when obliteration of the greater part of the cavity



occurred, either by re-expansion of the lung or by collapse of the chest wall. It was determined early in our observations that the pleurobronchial fistula was a major factor in producing chronicity, and it became apparent that any attempt at closure of these fistulæ in a septic field was useless and dangerous.

With these complications playing such a prominent part in the chronicity of this condition, it was deemed necessary to attempt some operative procedure which, from the very nature of the technic itself, would obviate any and all of these factors and, at the same time, permit a patient with low vital capacity and little resistance to undergo the necessary surgical treatment and, at the same time, have the accompanying shock reduced to a minimum.

Since the complete procedure could not be done at one time with safety to the patient, a fractional or step-like operation was adopted in which no previous step would be nullified by the lapse of time intervening between the subsequent phases.

At this point I wish to emphasize the fact that these patients were not improving. For three or four years the majority of them had maintained their cavities and had continued to discharge pus from them. By the marked thickening of the parietal pleura, Nature had apparently accomplished as much obliteration as possible, but despite her efforts, there still remained an appreciable cavity with a collapsed and non-functioning lung and a pleuro-bronchial fistula in 60.8 per cent. of the cases.

All these patients require some form of operation that would give them a complete cure; consequently postponement was out of the question, for as time elapsed, they would continue to grow progressively worse and become poorer surgical risks. It was therefore necessary to take the case in hand before some secondary condition intervened to snuff out what little vitality remained. Furthermore, from the economic standpoint alone, an operation of this character was justified, for if hospitalization could be terminated, and the patient healed and restored to at least a fraction of his former earning capacity, he became an asset rather than a liability to the community.

With all the foregoing requisites, the following plan of procedure was ultimately adopted:

During the pre-operative treatment, the patient, after being admitted to the Empyema Service, is placed on a high caloric diet; cultures from the cavity are sent to the laboratory to ascertain the organisms present; routine laboratory examinations of the blood, including red, white, and differential counts, together with estimation of the hæmoglobin, are made; the Wassermann reaction is taken; urinalyses are made; the sputum examined for tubercle bacilli; the blood chemistry determination is made when indicated and the vital capacity determined. Preliminary Dakinization of the cavity for a few days prior to the operation is carried out in order to cleanse it and, at the same time, to render the patient less septic, while in the interim, careful blood-pressure readings are made. The patient is typed and his blood checked against that of the prospective donor for agglutination and hæmolysis. A high compound enema is given at 6 A.M. on the morning of

the operation and no breakfast; morphine sulphate grain  $\frac{1}{4}$  and atropin sulphate grain  $\frac{1}{150}$  are administered in the ward one and one-half hours before operation. One-sixth of a grain of morphine sulphate is given thirty minutes before the operation is actually begun. Paravertebral anæsthesia is instituted by using one-half per cent. novocain solution and this is combined with superficial and deep infiltration anæsthesia in the region of the operation. Nitrous oxide and oxygen are subsequently given to the point of analgesia only, which procedure in addition to relieving pain also serves the double purpose of allaying fright and rendering the patient less susceptible to his surroundings, thereby eliminating one of the elements in the production of shock. A pre-operative transfusion is done in cases that are markedly septic and greatly emaciated.

As concerns the operation itself, in our first cases, provided simple and dependent drainage existed, the usual procedure was to attack the uppermost portion of the cavity first; otherwise the lowermost portion of the cavity was exposed in order that effective drainage could be established at the earliest possible moment. In all our recent cases, it has been the policy to attack the cavity at its lowest part and this has proven a most satisfactory method of approach.

An incision is made over that portion of the cavity which it is desired to expose and which, after outlining its limits with bismuth paste, has been previously located with accuracy by the X-ray; the skin and superficial tissues having been incised and hemorrhage controlled, the superficial muscle layers of the chest are now exposed. Large forceps are used to clamp the muscle bodies before they are severed, thereby eliminating all hemorrhage which might arise from them. Each rib is detached from the immediate musculature for two or three cm. beyond the extent of the cavity on either side after the surrounding tissues have been infiltrated with one-half per cent. novocain solution, and the main portion of the rib is separated subperiosteally, but it is imperative that the subperiosteal separation does not extend to the point where the rib is to be divided, *i.e.*, it should stop a half inch from the point of rib section. In the presence of infection which has been found in one hundred per cent. of these cases, it is advisable to avoid subperiosteal resection at the point of rib division for the following reasons: (1) As has already been stated, osteomyelitis is present in 90 per cent. of these cases, with or without sequestration, and in almost every instance, it proved to be the "cut end of the rib" for one-half to three-fourths inch beyond the point of resection, which sequestration after one of the former operations done, as all such cases usually are, by the well-recognized subperiosteal method. These infected rib ends subsequently become detached and are displaced into the pleural cavity, either by muscle movement or pressure of the skin or scar tissue contracting over the site of the former operations, where they in turn become secondary foci of infection. (2) Again it has been demonstrated repeatedly during the war and afterwards, that the Bunge amputation which calls for the removal of the periosteum one-fourth inch above the

point of division of the bone, is invariably followed by sequestration when the bone is denuded to this extent, and even simple periosteal separation is also frequently found to be followed by similar results, especially in cases for re-amputation where there had been prolonged suppuration at some previous time. Consequently the periosteum is cut flush with the rib on section and no sequestration has been seen so far in any of the cases where this method has been followed. Realizing the added difficulty which this procedure involves, since hemorrhage is much greater here than where subperiosteal resection is practiced, every effort should be made to control the vessels in the vicinity of the ribs to be sectioned before they are cut through.

It must be apparent to all who have operated on this type of case that the onset of shock is usually simultaneous with the resection of the overlying bony structure of the chest wall. Therefore, at this stage of the operation, the anæsthetist is instructed to make careful readings of the systolic and diastolic blood-pressures and closely observe the pulse-rate and general condition of the patient at ten-minute intervals or less, reporting the same to the operator. We have made it an infallible rule to use this as a guide or check on the amount of operative procedure to be undertaken at any one step. When the systolic pressure drops to 90 mm. of mercury, the operation is discontinued at once, even if the general condition of the patient is good and the pulse-rate within the limits of safety, since experience has shown that in some cases a subsequent drop of ten to twenty mm. will occur, during the first hour or two after operation.

Having resected the bony structures overlying that part of the cavity to be exposed in this step of the operation, the parietal pleura is next incised and that portion of the cavity you are particularly interested in is now exposed to view. It is but a natural inclination for the operator to do as much as possible at one time, provided the patient's life is not being endangered, but on two occasions during the first operations in this series, when we thought that we were completely within the limits of safety, the patients rapidly passed into profound shock and died, although they had been on the table less than forty minutes. After such an experience, the value of brief and repeated operations was forcibly brought home to us. The cavity having been exposed to the extent desired, the skin is inverted over the severed muscle and anchored together with the muscle over the resected rib stumps by means of silkworm gut sutures. The object in doing this is to prevent the muscle and skin, which are necessary for the final closure, from retracting and becoming atrophied, and also to render the dressings less painful, since the sensitive areas are now covered with skin as a protecting covering as shown in Fig. 1.

Multiple sacri-fication is practiced on that portion of the skin sutured under tension to cause relaxation and to prevent sloughing. The dressing is then applied after eight to ten Carrel tubes are placed in the cavity in layers, interspaced with gauze, and the whole area gently packed in this fashion, while one Carrel tube is placed under each infold of the skin and muscle for forty-eight hours. The outer dressings are now applied and the patient, if his condition warrants, is removed to the recovery room. Should

his condition not warrant disturbance or removal, he is allowed to remain on the table and active restorative measures are promptly instituted to combat shock. These consist principally in the local application of heat, the administration of a shock enema composed of spiritus frumenti 60 c.c. and coffee 120 c.c. and the elevation of the foot of the table. While these measures are being carried out, normal salt solution is administered intravenously, while another assistant obtains blood for transfusion from the donor, who has been checked against the patient prior to operation and who is waiting in the next room.



FIG. 1.—Showing turning in of skin to protect wound edges.

The citrate method is employed and the blood is given to the patient through the same apparatus that is being used to administer the normal saline. If a second fall in blood-pressure occurs and the symptoms of shock still persist, another transfusion is given. However, this post-operative phase of shock should occur but rarely if the surgeon will only adhere to the fixed principles of the step-like operation. Only two cases in this entire series required a second transfusion.

All danger of shock being over, the patient is returned from the recovery room on the day fol-

lowing the operation to his respective ward. It is imperative that the ward surgeon who daily dresses these cases should be present at the operation so that he may be fully informed of the particular complications that existed and will understand the objective to be reached as well as the complications that may ensue. The routine treatment adopted in the post-operative care of these cases is the classical Carrel-Dakin technic em-

ployed in the sterilization of all septic wounds. The number of tubes depends upon the size of the cavity (Fig. 2). The cavity is then packed throughout its entire extent to prevent any overhanging of wound margins. It is important indeed that no portion of the exposed cavity be roofed over at any time by the encroachment of the contracting soft tissues or by unhealthy granulations. The dressings are changed daily, at which time the wound is thoroughly flushed out with Dakin's solution and the packing then reapplied.

As soon as the patient's general condition has improved to the point where operative procedure is warranted, he is again prepared in the manner described and more of the contiguous structures overlying the cavity are attacked. This procedure is continued until eventually the cavity is laid wide open in its entirety. In some instances there have been as many as five subcavities detected; most of them were missed by X-ray and not seen in former operations because of their very minute openings which would admit only the smallest probe, yet these openings led to cavities that held



FIG. 2.—Showing placing of tubes for Carrel-Dakin technic.

from 15 to 50 c.c., but were not made evident until after they had been Dakinized for ten days or two weeks. (Fig. 49.)

The collapsed lung is mobilized from its fibrous pleural covering in two ways, depending usually upon the character of the fibrous deposit in the thin-walled hæmolytic streptococcus pleura, too adherent to permit a line of cleavage, the lung is freed by the application of a two per cent. alcoholic solution of gentian violet in the form of a pack. This is applied for two

consecutive days, after which the cavity is re-sterilized by the constant application of Dakin's solution until the entire blue coating of devitalized tissue has exfoliated, when a second application of the gentian violet is made, if necessary. This solution has also been used in very thick pleuræ, but the action is slower except when employed in conjunction with discission. On our first cases this agent was used for three consecutive days, but it was soon discovered that the destructive action led to the breaking down of the superficial air cells and lung herniation which was alarming in one case. There was rupture of the pleura in a second case and hemorrhage in a third, so consequently this dye should be used with great care and never in this strength, except in the open type of operation. The other method of pulmonary mobilization practiced has been a discission after the method of Ransohoff in preference to surgical decortication, which is usually employed shortly before closure and sometimes in the wards without anæsthetic or pain to the patient.

Surgical decortication was practiced in some cases but it was found that the expansile power of the lung was lost much earlier than where the chemical decortication was practiced. By these methods, cavities of 500 c.c. have been reduced to 50 c.c, but these or any other methods of decortication will not produce expansion in a lung that has undergone fibrosis.

The cavity formerly of large capacity having been reduced to a minimum by expansion of the lung and when possible after seven consecutive sterile cultures have been obtained, is now ready for closure. It has been necessary, however, to close some cases where it was found impossible to get as many as seven consecutive sterile counts and the result so far in each case has been satisfactory and the treatment exactly the same, except that the temporary drainage was allowed to remain for an extra twenty-four hours. Several other factors also enter into the obliteration of these cavities, and regardless of what has been written relative to the diaphragm on the affected side not ascending in the presence of dense adhesions, it does occur. The other lung also tends to push over into the inadequately filled pleural space of the affected side and in this way helps to obliterate the cavity even when the mediastinum is fairly rigid. Granulation is also a factor in reducing the size of small cavities.

The subsequent closure of these empyema cavities can be accomplished in progressive phases if it is deemed necessary and in the same manner that a graded method was used to expose them. But before taking up in detail the technic of plastic closure, the closure of bronchial fistula deserves special mention, as this complication has proven one of the most intractable of all to eradicate. The fallacy of attempting to close these fistulæ in the presence of sepsis requires further emphasis, and even in the presence of repeated sterile cultures it is a question if it is always advisable to completely close any fistula in cases of this type, for even then one cannot be certain as to the complications which may arise; even in the hands of capable surgeons, closure

has been followed by such disastrous complications as lung and brain abscesses. In this connection, it might be well to mention, and it is probably fortunate too, that there is no absolutely reliable way by which every bronchial fistula can be closed. While the recognized method of purse-string suture with inversion will close some, it has been found in our experience that it is far more satisfactory to reduce the size of the bronchial fistula by surgical means such as partial suture and to allow it to close by granulation after stimulating local applications of two per cent. alcoholic solution of gentian violet. Some of our early cases were closed by suture and implantation of muscle over the closed fistula which was afterwards safeguarded by a Carrel tube left in the vicinity of the closure for forty-eight or seventy-two hours. Although this method is not advocated as being ideal, it is far less dangerous than the implantation of a skin flap which forms a much more resistant barrier in the event complications arise, as they often do, even in the hands of competent surgeons. Our greatest success in the closure of fistulæ has been through a combination of procedures which includes the mobilization of the lobe containing the fistula in the area in which the fistula emerges on the surface of the lung, and the local application of gentian violet as described above or the partial reduction of the size of the fistula by suture subsequently followed by the application of gentian violet. The actual cautery was used in some cases, but with success only in those very minute fistulæ which did not need much treatment. It is absolutely imperative that no attempt at final closure of the remaining cavity be made while a patent pleuro-pulmonary communication exists. Through such an opening the pathogenic bacteria constantly present in the upper air passages naturally find ready access to more susceptible overlying soft tissues, thereby causing continuous reinfection. This, in our opinion, is the explanation for the failures which occur in some of the other operative methods.

Having progressed thus far in the treatment of the case, and having eliminated all the elements concerned in its chronicity, the patient is now ready for plastic closure and is prepared for operation as stated before. Local anæsthesia with gas analgesia is again used, the skin is freed from the underlying muscle bodies and undermined to the required extent. The muscles which have been saved at the previous operation are sufficiently freed from their attachment to allow complete re-suturing over the remains of the cavity. All the muscle tissue necessary is utilized to obliterate the space and the remaining severed muscles are brought in apposition by sutures, restoring as far as possible the normal contour of the chest wall and producing flexibility with movable skin surface in all cases except where the muscles were destroyed by previous operations and infection. During the dissection for liberation of the skin and muscles, preliminary to final closure, all raw surfaces are kept covered with moist Dakin packs to check oozing and to maintain sterilization. The skin edges and underlying muscle structure are approximated by a figure of eight silkworm gut suture, after all the



FIG. 3.—Group showing marked deformity and rigid chest walls.



FIG. 4.—Group with no post-operative deformity and with flexible chest walls.





FIG. 5.—Showing general flexibility of chest and lack of deformity.



FIG. 6.—Showing general flexibility of chest and lack of deformity.

redundant scar tissue has been excised. Rubber dam and Carrel tubes are inserted along the line of sutures to allow for drainage, and multiple scarification of the skin is again resorted to wherever it appears that tension is interfering with the proper circulation of the part. The dressings are firmly applied to prevent the occurrence of any spaces between the contiguous layers of tissue and at the same time assist in obliterating the cavity.

Whenever the cavity is of sufficient size to render a complete closure impossible at one operation, an attempt should be made to close only the



FIG. 7.—Group showing flexible chest walls with but little deformity.

uppermost aspect of the cavity in this manner, leaving the remainder to be closed at subsequent operations. The Carrel tubes are removed in twenty-four hours; the rubber dam drainage in forty-eight hours and the sutures in seven days.

The following classification, based on the condition of the patients when admitted to the Empyema Service, is presented for convenience of description.

Group I. Patients belonging to this group present great post-operative deformities, moderate-sized cavities with a capacity of 300 to 500 c.c.; osteomyelitis of the ribs, rigid chest walls and diminished vital capacity due to the compression of fibrosis of the lung or both. (Fig. 3.)

Group II. No post-operative deformity is found in these cases and only moderate-sized cavities of 300 to 500 c.c., while at the same time the chest walls are flexible and the lung tissues capable of ready expansion when liberated from the resistant thick pleura. (Figs. 4, 5 and 6.)

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Group III. This group is characterized by no post-operative deformities, but presents enormous cavities varying in size from 1000 c.c. to the entire capacity of the side involved. Collapsed lung with fibrosis is always present as is a rigid chest wall, the result of cross-union due to osseous regeneration on the part of the ribs.

Group IV. No post-operative deformities and only small cavities with flexible chest walls and expansile lung tissue. (Fig. 7.)



FIG. 8.—An irregular group. The upper row showing very little deformity. The middle and lower rows moderate deformity.

Irregular Group: The upper row of the cases in this class have very little post-operative deformity. The middle and lower rows moderate post-operative deformities due to rib resection and osteomyelitis before admission. (Fig. 8.)

Owing to the fact that such a large percentage of these cases have complications such as osteomyelitis, bronchial fistulæ, secondary cavities, and multiple draining sinuses, they are not mentioned in the above groups, nor are they used as a basis for a more intricate classification of this condition.

Naturally some modification of the technic described is necessary usually to meet the exigencies of the type of case undergoing treatment.

In the treatment of cases belonging to Group I, where the deformity and destruction is so great that there is little or no available muscle tissue and the lung has undergone fibrosis, the existing deformity must perforce of circumstances be allowed to remain, but the empyema cavity itself is laid open. The

bronchial fistula are closed preferably by mobilization of the involved lung or by local applications, except in the case of a very large fistula which can be reduced in size by partial closure and afterward completely closed by local applications of gentian violet by a small applicator eliminating all dangers incident to sudden surgical closure of these fistulæ. The extreme cases in this group show no marked improvement in the vital capacity following operation.

In cases belonging to Group II, the entire cavity is laid wide open by the many-stage operation and after the closure of all bronchial fistulæ and decortication, the cavity is obliterated by expansion of lung and later closure effected according to the technic already described. The greatest number of chronic empyema cases belong in this group and they should have a flexible chest wall and practically no deformity following operation.

In the cases of Group III, when the entire lung is collapsed and bound down, the existing openings are enlarged to remove involved ribs and to permit direct Dakinization of the cavity as well as to provide for more dependent and better drainage. After all sinuses are laid open and sterilized, every effort should first be made to expand the lung by chemical decortication and discission. After the maximum expansion is obtained by the above methods, the remaining cavity is obliterated by some modification of the Wilms or Sauerbruch operations, provided all infected and necrosed ribs have been removed.

In cases belonging to Group IV, little if any treatment is necessary other than Dakinization after the cavity is laid widely open and the fistulæ closed, except plastic muscle closure following sterilization of the cavity.

It should be mentioned here that every effort is made to get these patients out of bed as soon as possible after each operation, usually on the second or third day.

Further after-treatment is as follows: The patient is kept on a high caloric diet, his weight is recorded at weekly intervals, and daily calisthenics in the nature of deep breathing exercises are instituted after healing has occurred.

Vital capacity readings are made on these cases following the closure and checked against the readings made on admission. It is interesting to note that there is a gain of anywhere from 500 to 1500 c.c. in lung capacity, which increase, I feel, is of decided importance to the patient as an evidence of heightened resistance to respiratory infections, a fact further substantiated by the sense of physical well-being experienced by these patients and a gain in weight varying from ten to forty pounds.

In our series of forty cases reported here, twenty-one were of from three to four years' duration; five were of two years' duration, and the remaining number varied from six to eighteen months.

Twelve of this number had radical operations of the most extreme form and twenty-four had multiple thoracotomies with removal of one or more ribs when admitted.

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The results in the series were as follows: Thirty-five closed; three died; one left hospital before ready for closure; one undergoing syphilitic treatment and ready for closure. One hundred and seventy-three operations were necessary to complete the work on these cases by the many-staged method.

In another series of over twenty cases recently admitted from the Veterans' Bureau, the time necessary for the completion of the treatment promises to be much shorter.

### CONCLUSIONS

1. The chronic type of empyema, especially those with large cavities, should occur but seldom if early aspiration followed by negative pressure treatment is promptly instituted.

2. Empyema cavities can be obliterated by discission and chemical decortication plus implantation of certain muscle bodies.

3. The patient's vital capacity and resistance to intercurrent disease can be increased by complete eradication of infection and the methods of decortication already mentioned.

4. Chemical decortication, if used injudiciously, may result in rupture of the visceral pleura, dangerous herniation of the lung, and hemorrhage, but the expanded lung retains its expansile power longer than when surgical decortication is practiced. (It should never be used in such a concentrated form except in the open type of operation.)

5. The pleuro-bronchial fistula is one of the commonest causes of persistent cavities.

6. Subperiosteal resection of ribs at the point of division should be discarded and rib section flush with periosteum adopted.

7. Obliteration by expansion of lung which means increased vital capacity should be practiced rather than cavity diminution by collapse of the chest wall.

8. Sterilization of the cavity can often be accomplished even in long-standing cases, but re-infection will invariably occur if the parietal pleura is not removed in a case of over one year's duration, especially if it is of the hæmolytic streptococcus variety.

9. Daily cultures of the wound are necessary to check the progress and to determine the amount of Dakin's solution to be used.

10. The many-step, open or fractional operation, has the following advantages:

(a) It permits direct inspection and Dakinization of the entire cavity.

(b) It permits the detection and eradication of diverticulæ which are often missed on X-ray examination.

(c) It aids in the detection of osteomyelitis and foreign bodies.

(d) It insures such immediate improvement in profoundly septic cases that they will permit further operative procedure being carried out with low mortality.

(e) It affords easy removal of the parietal pleura and discission or chemical decortication of the visceral pleura.

(f) It allows the detection and direct closure of bronchial fistula.

(g) The operation can be discontinued at any stage, only to be finished later when the patient's condition permits with a mortality far below that of the standard radical operation.

As regards the treatment of this type of case, our entire procedure is based upon the recognition of the soundness of the contention learned in the school of experience, that there is no short cut nor abbreviated method whereby a cure can be obtained. Like every new departure in surgery, the operative technic is naturally the paramount prerequisite of that particular method, yet, in this instance, constant and careful Dakinization, together with massive and irksome daily dressings necessary to ensure sterilization, are indispensable desiderata in obtaining an ample reward for all the hardship the patient has endured.

In conclusion the author feels that he would have been decidedly remiss did he fail to acknowledge his indebtedness to Captain Arthur D. Haverstock and Captain C. E. Dovell, Medical Corps, U. S. Army, to whose lot fell the bulk of the routine ward treatment of these cases. Captain Haverstock was associated with him in the early part of this work and by close observation and tireless efforts did much to produce the results obtained at that time. Captain Dovell has subsequently carried on with success the major portion of the experiments, and has done all the practical work in developing the technic in regard to the use of gentian violet, both for decortication purposes and for the treatment of bronchial fistulæ. He has also made it possible to handle the intercurrent and resistant pyocyaneus skin infections, through his introduction of the use of twenty per cent. silver nucleate in the treatment of such annoying conditions.

Grateful acknowledgment is hereby made to these two officers for their cordial coöperation and unremitting assistance in carrying on this work.

#### CASE RECORDS \*

CASE I.—R. G. H., age thirty-three years, developed influenza and pneumonia September 8, 1918, complicated by empyema, left pleural cavity, hæmolytic streptococcus type, September 18, 1918. Aspirated twice.

October 22, 1918. Thoracotomy; resection of 10 cm. of seventh rib, mid-axillary line, with the institution of drainage and irrigation with Dakin's solution.

September 10, 1919. Decortication operation with resection of seventh, eighth, ninth and tenth ribs; dependent drainage.

Patient received a number of minor operations to institute drainage.

Admitted to Empyema Service, September 24, 1920.

Condition on admission: Stretcher case; poorly nourished; anæmic; very much under weight—normal weight 155 pounds; present weight, 117 pounds; fingers clubbed; extremities œdematous.

Examination of chest revealed sinus discharging pus ninth interspace, mid-axillary line, left chest, with a large irregular-shaped cavity extending from second to eighth rib, mid-axillary line (Fig. 9).

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\*Twenty cases only are included in these records, owing to the want of space for the entire series.

## THE TREATMENT OF CHRONIC EMPYEMA

Radiographs showed marked collapse of left lung with extensive scar formation and marked thickening of parietal pleura, left lateral chest, with considerable proliferation of new bone formation from resected ribs and some osteomyelitis of rib stumps. Small secondary cavity or diverticulum extending into the hilus of lung. Capacity of cavity, 300 c.c.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 13,950; red blood-cells, 3,810,000; urine negative; culture from cavity showed heavy growth of hæmolytic streptococcus. Blood-pressure: systolic, 110; diastolic, 80; pulse-pressure, 30; vital capacity reading, 1500 c.c.

December 9, 1920. Operation.—Resection of 15 cm. of third, fourth, fifth and sixth ribs, postular scapular line, left chest; cavity laid wide open and preparation for active Dakinization.

February 4, 1921. Operation.—Resection of 10 cm. of seventh, eighth, ninth and tenth ribs, posterior axillary line; excision of thickened parietal pleura, forming roof of cavity; skin inverted over muscle and saved for final closure. Entire cavity exposed over posterior aspect and active Dakinization continued.



FIG. 9.—Case I. Showing great emaciation when admitted. High incision to reach extra-pleural extension of infection.

April 7, 1921. Operation.—Resection of 10 cm. of sixth, seventh and eighth ribs, anterior axillary line; left chest and the anterior aspect of cavity laid wide open for the continued Dakinization. Discission of visceral pleura to allow lung expansion and the thickened parietal pleura excised.

May 6, 1921. Operation.—Partial plastic closure upper aspect of posterior cavity; implantation of a portion of subscapularis and infraspinatus muscle into apex of cavity; superficial muscles, which had been saved at previous operation, brought in apposition and sutured; skin closed by silkworm gut; multiple scarification of skin to cause relaxation; active Dakinization continued.

June 21, 1921. Operation.—Partial closure; anterior aspect of cavity; superficial muscles brought in apposition and sutured; skin closed with silkworm gut. Posterior aspect of cavity left open for active Dakinization.

July 18, 1921. Operation.—Removal of segments of seventh, eighth and ninth ribs, which had previously been resected in anterior axillary line and detached posteriorly when cavity was laid wide open. Active Dakinization continued (Fig. 10).



FIG. 10.—Case I. Regenerated necrosed ribs exposed for removal.

February 24, 1922. Incision of scar in posterior scapular area; removal of necrosed rib stump which had been left extrapleural at last operation. Wound left wide open for active Dakinization and observation.

March 1, 1922. Empyema cavity completely obliterated; lung well expanded; had been healed since November 20, 1921; rib resection above has no relation to empyema.

April 15, 1922. Patient improving; exposed to sun daily; on calisthenics and lung exercises; appetite good, weight and strength returning.

June 26, 1922. Patient entirely healed; X-ray shows all cavity formation obliterated; lung well expanded; general condition excellent; weight on admission

September 8, 1921. Operation.—Resection of 5 cm. of regenerated tenth rib stumps, which had become osteomyelitic. Dakinization continued.

November 9, 1921. Secondary closure with implantation of superficial muscle body in remaining cavity formation. Additional superficial muscles brought over the implantation and fixed, leaving the resected rib stumps extrapleural when skin was brought in apposition. This was done because case was considered tubercular, due to extensive rib necrosis; should there be any additional necrosis of rib stumps, condition would be extrapleural and localized.



## THE TREATMENT OF CHRONIC EMPYEMA

117 pounds; present weight 140 pounds; vital capacity reading, 2300 c.c. (Fig. 11).

Factors to be combated in this case are:

1. Haemolytic streptococcus infection.
2. Osteomyelitis of ribs and rib stumps with bridging and overlapping.
3. Secondary cavity and diverticuli.
4. Marked regeneration with bridging and overlapping of previously resected rib, rendering an almost solid plate of bone to be removed.

CASE II.—C. G., age thirty-three years, developed influenza and pneumonia, October 21, 1918, complicated by empyema, left pleural cavity, haemolytic streptococcus type, November 16, 1918; aspirated four times.

November 22, 1918. Thoracotomy, resection of portion of seventh rib.

March 3, 1919. Additional rib resection and drainage instituted.

May 3, 1919. Operation.—Resection of 20 cm. of eighth rib, posterior axillary line, left chest; Carrel tube inserted and good drainage instituted.

Treated by this method until June 24, 1919, when he was transferred to Oteen, N. C., on a diagnosis of suspected tuberculosis.

August 7, 1919. Operation.—Resection of portions of sixth, seventh, and eighth ribs; Dakinization continued.

October 31, 1919. Estlander type of operation with resection of portions of third, fourth, fifth and sixth ribs and a portion of the regenerated seventh rib, with partial collapse of the left chest wall. Drainage instituted.

February 19, 1920. Resection of portions of second, third and fourth ribs, mid-clavicular line, thus causing additional collapse of left chest wall.

June 2, 1920. Incision made over seventh, eighth and ninth ribs and necrotic posterior stump resected.

Admitted to Empyema Service, January 17, 1921.

Condition on admission: Ambulatory case; anæmic, highly septic; poorly

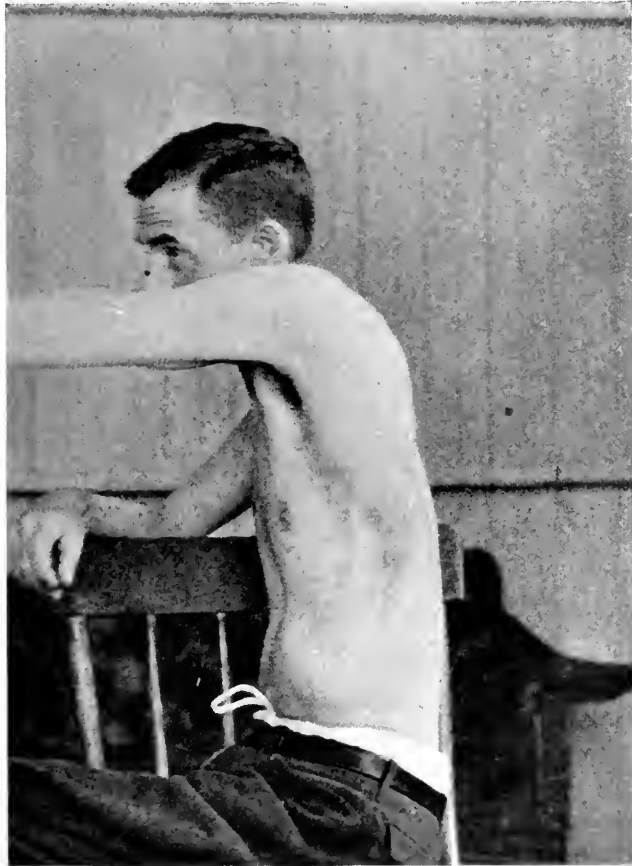


FIG. 11.—Case I. Final result.

nourished and considerably under weight. Normal weight 175 pounds; present weight 110 pounds. Fingers clubbed; extremities œdematous.

Examination of chest revealed multiple sinuses in scars of previous operations, leading down to resected rib stumps, which had become osteomyelitis; marked deformity in contour of left chest due to previous collapsing operations (Fig. 12). Large cavity formation extending from first rib to tenth rib, lateral chest.

Radiograph showed marked collapse of left lung with extensive thickening of the pleura from apex to base and a bismuth-filled cavity, as noted above, with a capacity of 400 c.c. with osteomyelitis and sequestration of rib stumps.



FIG. 12.—Case II. Showing condition of patient when admitted to Empyema Service, with multiple fistula and general osteomyelitis.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; blood count: white blood-cells, 10,300; red blood-cells, 3,640,000; urine negative; culture from cavity showed heavy growth of hæmolytic streptococcus. Blood-pressure: systolic, 108; diastolic, 80; pulse-pressure, 28; vital capacity reading, 1500 c.c.

*Surgical Treatment, Fractional Procedure.*—January 21, 1921. Incision along posterior scapular line, with resection of necrotic rib stumps; excision of thickened parietal pleura and scar tissue; skin inverted over muscle to preserve for final closure; cavity left open for active Dakinization.

March 16, 1921. Resection anterior portion of eighth, ninth and tenth rib stumps, with excision of roof of cavity; removal of all thickened pleura; discission of visceral pleura to allow lung expansion; active Dakinization continued.

April 8, 1921. Resection of fourth, fifth and sixth ribs, mid-axillary line; excision of thickened pleura; exposure of entire cavity; dakinization continued.

May 7, 1921. Resection of necrotic rib stumps; discission of visceral pleura to allow lung expansion; Dakinization continued (Fig. 13).

June 3, 1921. Partial plastic closure of lower part of cavity converging with diaphragm; implantation of portion of superficial muscle body into same and a

## THE TREATMENT OF CHRONIC EMPYEMA

plastic skin sutured over defect; Dakinization continued in upper aspect of cavity.

July 11, 1921. Partial plastic closure of upper posterior aspect of cavity by means of implantation of a portion of the subscapularis and infraspinatus muscle, to obliterate the remaining portion which had not been obliterated by lung expansion. Skin and superficial muscles brought in apposition and sutured. Remaining portion of cavity left open for active Dakinization.

November 28, 1921. Resection of necrotic rib stumps third, fourth and fifth ribs, anterior aspect; excision of overlying thickened pleura. Removal of detached sequestered rib stump from apex of remaining cavity formation. Active Dakinization continued.

February 3, 1922. Plastic closure of remaining cavity formation by means of implantation of superficial muscle bodies which had been saved at previous operation; remaining superficial muscle structure brought in apposition and sutured. Excision of scar formation along skin margin and skin closed by silk-worm gut. Multiple scarification of skin to cause relaxation. Rubber dam drainage for forty-eight hours (Fig. 14).

March 11, 1922. Cavity completely obliterated: lung well expanded.

X-ray shows no evidence of osteomyelitis of remaining rib stumps. General condition good. Patient gaining weight.

June 21, 1922. Excision of old adherent scar and plastic skin closure of area with silk-worm gut; multiple scarification of skin to cause relaxation; rubber dam drainage forty-eight hours.

June 28, 1922. Skin area entirely healed; lung expanded in apposition with chest wall; general condition excellent; weight on admission 110 pounds; present weight 125 pounds; vital capacity reading, 1900 c.c. (Fig. 15).



FIG. 13.—Case II. Showing defect after resection of necrotic ribs.

Factors to be combated in this case are:

1. Hæmolytic streptococcus infection.
2. Osteomyelitis of rib stumps.
3. Numerous collapsing operations left chest wall with bridging and overlapping by regenerated rib formation.
4. Marked disturbance of metabolism due to deviation of mediastinum.

Patient could not withstand any fractional operation without all of the measures to combat shock.

June 30, 1922. Patient will be given a thirty-day leave and will be ready for discharge from hospital on his return.

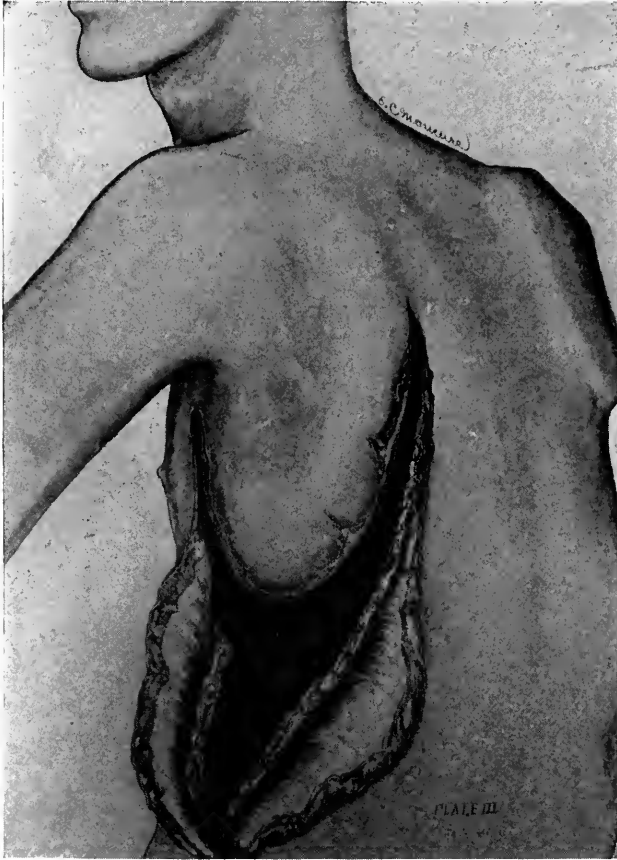


FIG. 14.—Case II. Process of plastic closure by muscle implantation. under weight. Radiograph shows a dense shadow over the right base, suggestive of fluid. There is thickened pleura from base to apex. The lung is collapsed. There has been a resection of the third to eleventh ribs inclusive, with bone proliferation and bridging.

The external right chest resembles the contour lines of a map from the many previous lines of incision. Patient has had to date twelve operations from simple thoracotomy to the extensive collapsing and mutilating type of operation.

Bacteriological examination: Wassermann negative; sputum negative for

CASE V.—L. J. McC., age twenty-four years, developed pneumonia February 18, 1919, complicated by empyema, right pleural cavity, hæmolytic streptococcus type, February 22, 1919.

Received eleven operations prior to admission to the Empyema Service, including thoracotomies, Schede and Estlander type of operation, with resection of third to eleventh ribs inclusive, right side, and attempted resection of second rib, right side.

Admitted to Empyema Service, November 15, 1920.

Condition on admission: Patient acutely sick from accumulation of pus in old healed cavity. Patient is about 25 pounds

tubercle bacilli; blood shows slight anaemia with high leucocyte count, due to acute condition. *Streptococcus haemolyticus* has been the prevailing and dominant organism in this case from the beginning.

January 10, 1921. Patient showed evidence of re-accumulation of pus in chest. Needling with trocar canula and threading of small drainage tube into cavity permitting escape of pus. On attempting to use Dakin solution, it was found that patient had a pleurobronchial fistula and the solution had to be discontinued.

*Surgical Treatment, Fractional Procedure.*—January 31, 1921. Incision in line of previous incision in anterior axillary line. Portion of fifth rib resected. Cavity left open in preparation for active Dakinization.

April 11, 1921.

Exposure of cavity posteriorly and further exposure anteriorly with resection of necrotic rib stumps of sixth, seventh and eighth ribs posteriorly, and fourth, fifth and sixth ribs anteriorly. The two incisions were separate and not connected externally, but a narrow sinus led from one to the other within the cavity proper. Both wounds left widely open for Dakinization.

April 21, 1921. Incision connecting the anterior and posterior wounds; dissection of connecting sinus tract internally with excision of intervening rib stumps. The chest now presented one large deep wound of about 500 c.c. capacity. Cavity left widely open for active Dakinization.

May 18, 1921. Small sinus tract found in upper angle of wound and excised.

June 8, 1921. Plastic closure. The bronchial fistula was still patent and had resisted closure by cauterization. At this operation, the cavity which had obliterated about 75 per cent., could be entirely obliterated by the implantation of muscle bodies lying along the upper and lower margins of the cavity. The bronchial fistula was closed by mobilizing it, inserting a purse-string and slightly inverting it, then the area was carefully covered in by a small muscle implantation sutured



FIG. 15.—Case II. Final result.

*in situ* (Fig. 16). The skin and subcutaneous tissues were freely undermined on both sides and the tissue united by sutures under some tension. Rubber tissue drainage. Only superficial muscle slough followed.

July 26, 1921. There was a little undermining of the skin in the middle third of the wound with slight slough due to tension. Superficial incision was made and the skin divided. Wound allowed to granulate. Following this the wound gradually healed.

August 12, 1921. Almost healed; Dakin's has been stopped and gentian violet

is being used instead, as there is only a small place in the skin to close.

September 2, 1921. Patient healed; looks fine; feels strong; appetite good; gaining in weight.

October 1, 1921. Patient granted two months leave of absence.

May 11, 1922. Patient has been healed eight months; discharged cured (Fig. 17).

Factors to be combated are:

1. Streptococcus hæmolyticus.
2. Massive collapse of lung with an almost total pneumothorax.
3. Numerous diverticulæ and recesses which infected, and having no drainage, were the foci of frequent recurrence.

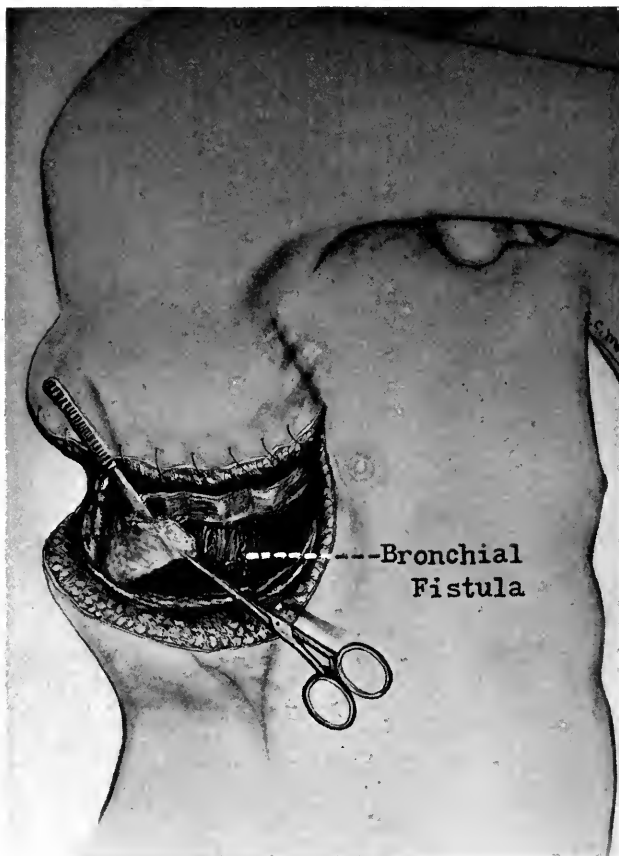


FIG. 16.—Case V. Showing bronchial fistula and process of plastic closure by muscle implantation.

4. Sequestra following extensive involvement of many of the rib stumps.
5. At the time of the first fractional operation, the chest wall was so scarred from twelve previous operations and there was such extensive cross-bone formation and bridging that operation for the removal of these structures overlying the cavity was made extremely difficult.
6. Pleurobronchial fistula present.

CASE VI.—M. C. B., age twenty-seven years, developed pneumonia, right lower lobe, April 26, 1918, complicated by empyema, right pleural cavity, May 1, 1918. Aspirated May 2, 1918, and 500 c.c. of fluid removed. Aspirated every other day and fluid removed on ten occasions.

## THE TREATMENT OF CHRONIC EMPYEMA

May 28, 1918. Intercostal thoracotomy. Wound drained for five months following this. Patient had intermittent Dakinization.

August 15, 1918. Bismuth paste injected into cavity and wound allowed to close. Capacity of cavity at this time about 500 c.c. Wound remained closed until November, when the sinus reopened and drained for a period of three weeks. Sinus again allowed to close and remained closed until March, 1919, when it was again reopened and continued to drain pus until the latter part of May, 1919. Cavity remained healed until June, 1920.

June 11, 1920.

Operation at a civilian hospital and part of the sixth rib resected. From this time on until he was admitted to Empyema Service, Walter Reed General Hospital, he continued to drain pus quite freely.

Admitted to Empyema Service, January 10, 1921.

Condition on admission: Normal weight 150 pounds; present weight 132 pounds. Patient anæmic and undernourished. Highly septic. Examination of chest revealed sinus at the level of the ninth interspace in the posterior axillary line, discharging pus freely. Sinus extends upward and backward and is apparently 20 cm. long.



FIG. 17.—Case V. Final result

Radiograph of chest shows resection of the sixth, seventh and eighth ribs and a partial collapse of the right lung. There is thickening of the pleura from the base to the apex. There is definite osteomyelitis with probable sequestration of the sixth rib. The sinus passes upward and backward from the level of the eighth rib and terminates in an elongated cavity which reaches the fifth interspace posteriorly. Measurements of the capacity of the cavity show that it holds about 400 c.c.

Bacteriological examination: Red blood-cells, 4,400,000; white blood-cells, 12,850; hæmoglobin, 75 per cent. Wassermann negative; urine negative; blood culture negative; sputum negative for tubercle bacilli; culture from exudate of

the cavity shows staphylococcus aureus and also streptococcus hæmolyticus.

Patient was placed on active Dakinization for three days previous to operation.

January 13, 1921. Partial resection of eighth and ninth ribs for drainage purposes only, with removal of the outer and lower wall of the cavity.

Following this operation, patient was treated intensively with Dakin's solution until February 15, 1921, when the second step of the operative procedure was done. At this time there was resection of the fifth, sixth and seventh ribs posterior, with an excision of all tissues forming the roof of the cavity. Cavity was

left widely open and actively Dakinized.

April 8, 1921.

The third step was undertaken. Sections of third, fourth, fifth and sixth ribs were removed; sterile cultures of the wound having been obtained, prior to operation, it was thought advisable to attempt to obliterate the upper angle of the cavity by muscle implantation. A part of the erector spinæ muscle was split and implanted into the apex of the wound and sutured in place. Practically all of the muscle thus implanted was retained and there was but little sloughing. The lower part of the wound seemed to be obliterating rapidly

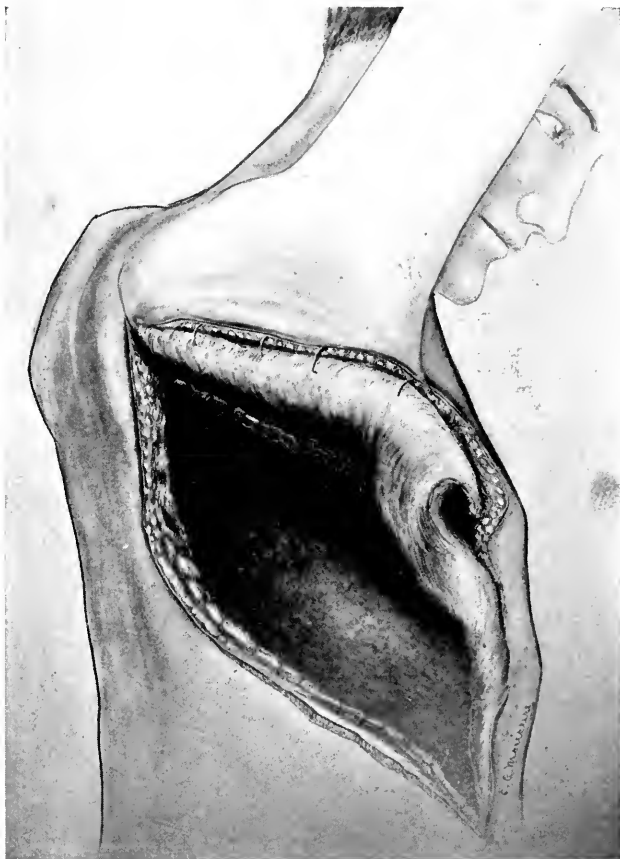


FIG. 18.—Case VI. Showing closure of upper portion of cavity by muscular transplant.

and the patient's general condition had been improved considerably (Fig. 18).

May 2, 1921. X-ray showed an osteomyelitis with sequestration of the terminal end of the previously resected third rib. The muscle body, which had been implanted filling in this area, was split and the sequestration removed.

July 7, 1921. Operation.—A small fistulous tract found leading down to the ninth rib stump. This portion of the rib resected and a plastic closure of the lower half of the wound by implantation of the contiguous muscle bodies was done. The skin was undermined on either side and brought forward, covering in all of the lower half of the wound (Fig. 19).



FIG. 19.—Case VI. Implantation of contiguous muscle bodies.



FIG. 20.—Case VI. Final Result.



July 27, 1921. Operation.—Plastic closure of the upper half of the wound by implantation of subscapularis muscle and sliding skin flap from either side brought forward and sutured. Rubber tissue drainage placed in the line of closure and a firm dressing applied to the wound.

October, 1921. Patient entirely healed and feeling fine. At the time of the first plastic operation, the capacity of the cavity had diminished to about one-fourth of its original size. On discharge the X-ray showed moderate collapse of the right chest wall; a rather marked thickening of the pleura but no cavitation and

with the lung well expanded.

Patient discharged cured January 5, 1922. Healed three months (Fig. 20).

Factors to be combated in this case are:

1. *Hæmolytic streptococcus* organism present.

2. Osteomyelitis with rib sequestration.

3. Beck's bismuth paste which had remained in cavity thirteen months.

4. Three diverticulæ draining into main cavity.

CASE VIII.—S. R., aged twenty-eight years, developed pneumonia March 30, 1918, complicated by empyema, right pleural cavity, hæmolytic streptococcus type, April 3, 1918. Aspirated.

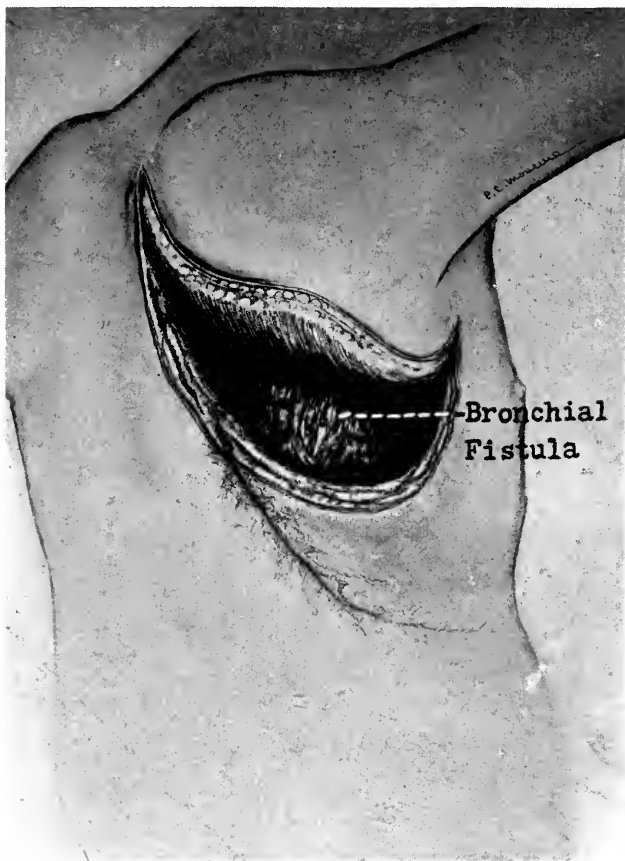


FIG. 21.—Case VIII. Showing extent of incision and position of bronchial fistula.

April 3, 1918. Intercostal thoracotomy seventh interspace, mid-axillary line, and drainage instituted; daily irrigation with Dakin's solution and dichloramine.

June 10, 1918. Another cavity found draining into the one that was opened; capacity of same now 450 c.c.; Dakin tubes inserted and classical Carrel-Dakin technic for the sterilization of wounds instituted through primary incision. Daily aspiration of other areas of chest, and cavity wound would close and cavity would again fill with pus and drainage would be re-instituted by opening up the original wound. Formalin and glycerin 2 per cent. were used, but no improvement noted. Treated by this method of procedure for some time and when wound would close, negative pressure treatment was tried.

## THE TREATMENT OF CHRONIC EMPYEMA

January 14, 1919. Operation.—Resection of a portion of the ninth rib posterior axillary line right chest; dependent drainage instituted and active Dakinization started.

August 19, 1919. Decortication operation with fish-hook incision and resection of fourth, fifth, sixth, seventh, eighth, ninth, tenth and eleventh ribs; outer wall of cavity removed en masse; visceral pleura decorticated. Muscle and skin closure with one drainage tube in dependent portion of wound.

September 23, 1919. Wound healed. January 10, 1920. Wound re-opened cavity present. Bronchial fistula noted and hæmoptysis with persistent cough; almost impossible to irrigate the cavity with any solution due to the fistula.

August 19, 1919. Diagnosed as chronic parenchymatous nephritis in conjunction with empyema; cavity kept open and irrigated in spite of patent fistula. Hæmoptysis persisted; dressed and treated in the manner stated until November 1, 1920.

Admitted to Empyema Service, November 20, 1920.

Condition on admission: Ambulatory case, anæmic, highly septic, poorly nourished and considerably under weight. Normal weight 147 pounds; present weight 117 pounds. Persistent cough with frequent expectoration of purulent blood-tinged sputum.

Examination of chest revealed marked deformity in the contour of the right chest wall due to collapsing operation. A sinus discharging pus, posterior scapular line, at a level corresponding to eighth rib, was present.

Radiographs showed marked collapse of right lung with extensive thickening of pleura, right chest, from apex to base, and a long cavity formation extending from second to ninth rib, lateral chest, with a capacity of 300 c.c. A large pleuro-

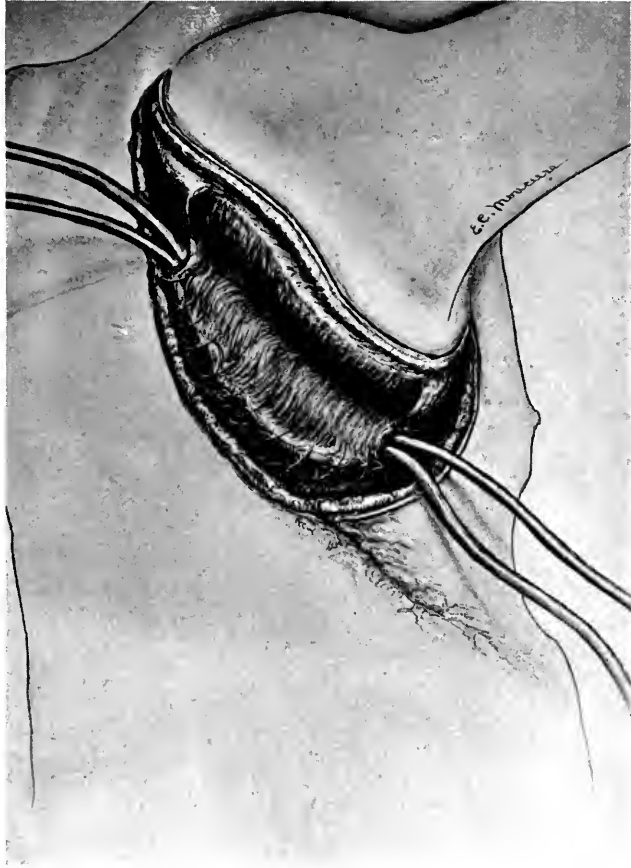


FIG. 22.—Case VIII. Implantation of levator anguli scapuli and erector spinæ muscles over bronchial fistula.

bronchial fistula present and some regeneration and overlapping of rib stumps with osteomyelitic changes.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 12,300; red blood-cells, 3,480,000; urine showed heavy trace of albumin; culture from cavity showed heavy growth of hæmolytic streptococcus; blood-pressure: systolic, 148; diastolic, 90; pulse-pressure, 58; vital capacity reading, 1500 c.c.

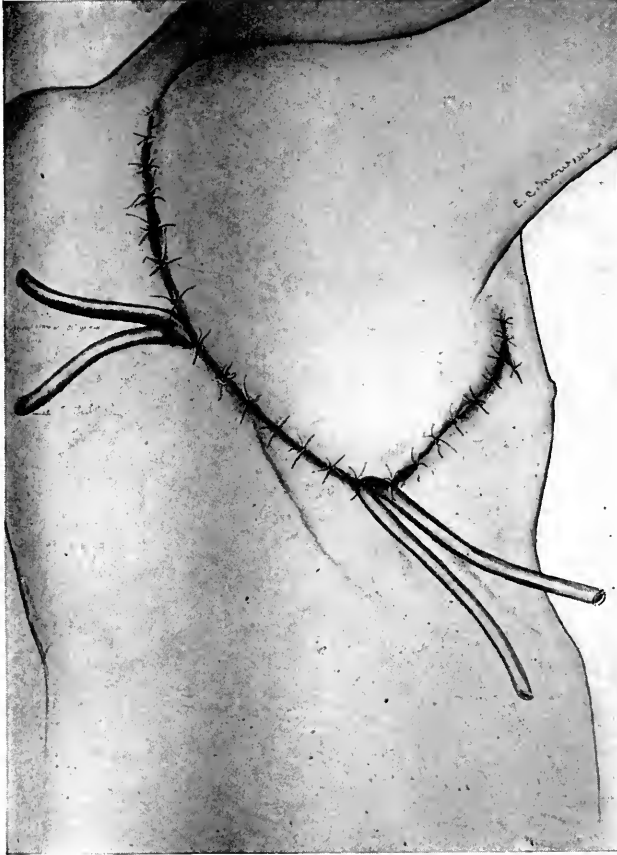


FIG. 23.—Case VIII. Secondary closure.

*Surgical Treatment, Fractional Procedure.*—November 29, 1920. Operation. Incision along old posterior scar line and extended by a "U"-like figure to anterior axillary line; entire cavity laid wide open; excision of all thickened pleura forming roof of cavity; skin and remaining muscle tissue saved for final closure. Fistula noted and mobilization of lung about same preparation of cavity for active dakinization.

January 20, 1921. Operation.—Resection of 10 cm. of second, third, fourth and fifth ribs, posterior scapular line, right chest; implantation of a portion of the

## THE TREATMENT OF CHRONIC EMPYEMA

levator anguli scapuli and erector spinæ muscles into apex of cavity over pleuro-bronchial fistula, and closure of upper aspect of cavity, muscle and skin. Cavity about sterile, but active Dakinization continued in lower aspect, which was left open (Fig. 22).

June 1, 1921. Secondary closure of remaining wound; severed superficial muscles and skin brought in apposition and sutured; rubber tube and rubber dam



FIG. 24.—Case VIII. Final results.

drainage for forty-eight hours; multiple scarifications of skin to cause relaxation (Fig. 23).

July 12, 1921. Operation.—Fistula still patent; small incision over posterior aspect in old scar line. Lung mobilized about fistula. Tract ligated by means of purse-string and another muscle flap implanted over area of closed fistula. Wound packed and allowed to granulate.

August 4, 1921. Fistula still patent. Treated with two per cent. alcoholic solution of gentian violet and the next day the communication was closed and remained closed. Wound granulated and entirely healed on August 22, 1921.

September 30, 1921. Patient shows all cavity formation obliterated; lung well expanded and fistula remaining closed; is gaining weight; general condition excellent.

October 10, 1921. Patient cured; weight on admission 117 pounds; present weight 140 pounds. General condition excellent; vital capacity, 2300 c.c.

Factors to be combated in this case are:

1. Hæmolytic streptococcus present.
2. Osteomyelitis.
3. Nephritis.
4. Pleurobronchial fistula.
5. Marked destruction in soft tissues and deformity of chest wall.

Patient discharged cured, January 7, 1922, healed four months.

(TO BE CONTINUED)

## PULMONARY FAT EMBOLISM \*

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PULMONARY fat embolism has been most often noted in cases of fractured bones.<sup>1</sup> It has long been known that free liquid fat is present in the blood following injury to fatty tissue, and emboli in other organs have been observed. Just why the bulk of fat, when placed into the blood-stream, should lodge in the lungs is a matter of speculation. Gauss has shown that by the simple addition of oil to blood the viscosity is greatly increased, thereby slowing the stream as it passes through the lung capillaries which are long and poorly supported.

It has been shown that pulmonary fat embolism is at least a potential factor in the cause of death following any surgical operation in which fatty tissue has been injured. The condition may occur following any type of operations in the abdomen through the abdominal wall, following removal of the mammary glands, both radical and simple herniotomy, inguinal and ventral, removal of fatty tumors, thyroidec-tomy, and injury to bony tissue, especially by fracture. Warthin also found it following burns.

*Etiology.*—Man normally has from 0.5 to 0.85 per cent. of fat in the blood. The amount may be increased somewhat by ingestion. In certain diseases, such as diabetes mellitus, nephritis, tuberculosis, malaria, and cholera and also following poisoning by phosphorus and carbon monoxid, the fat content of the blood is increased. In order to permit the entrance of fat into the circulation in amounts even to approach the amount of free fat in the blood-stream in pulmonary fat embolism, there must first be injury to the fatty tissue, and second a break in the continuity of the blood-stream. Entrance of fat into the circulation by way of the lymphatics is lightly regarded.<sup>1</sup> If the vascular system is injured sufficiently to take up fat, there are several factors which make it easy literally to fill the blood-stream with

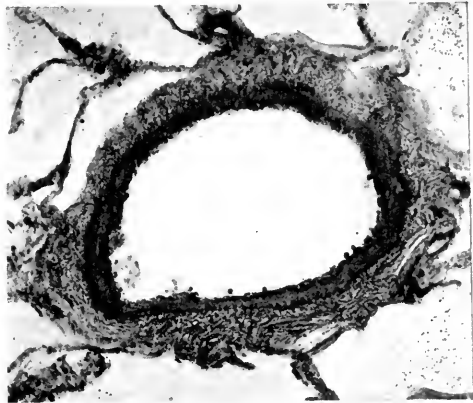


FIG. 1.—(Case A176353). Section through a large vessel showing small fat droplets. From the size of the vessel this is probably the amount of fat that is free in the blood-stream. (x 50.)

\* Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota, in partial fulfillment of the requirements for the degree of Master of Science in Surgery, June, 1921.

free liquid fat. Partial hæmostasis is particularly important. Other factors are mobility of the injured parts, weakened circulation, incomplete or shallow breathing, and inhalation of lipoidal solvents. Bissell believes that certain fats, from the gross appearance, are probably more readily taken up by the blood than others.

That incomplete hæmostasis is an important factor is shown by the fatal cases in which operations have been performed on the abdominal wall. Almost without exception hæmatomas filled with fat droplets have been found at necropsy. The same may be said of operations on the breast which have had a fatal outcome from pulmonary fat embolism.

I believe that mobility of the injured tissue is probably the most important factor in the etiology, if there is injury to the fatty tissue and a break

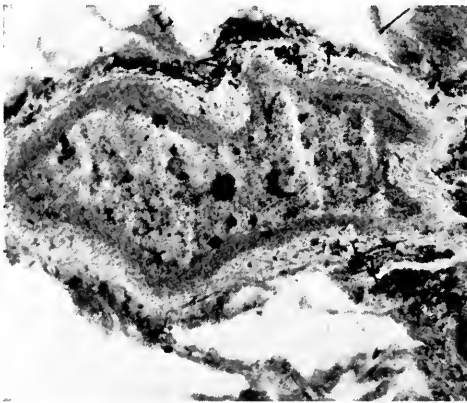


FIG. 2.—(Case A179570). Exudate from a bronchus containing fat. (x 50.)

in the venous or capillary circulation. In the abdominal wall and in the chest wall mobility depends on the rate of respiration. There are generally at least eighteen complete excursions each minute, and these may be increased to forty or more. If excavation is performed, and it usually is, this, by a vacuum effect, causes free fat to be forced into the opened blood-stream. Then, negatively speaking, in the Kondoleon operation in which a large amount of fatty tissue is destroyed no deaths from pulmonary fat embolism have been reported. The

limb, following operation in these cases, is firmly bandaged and kept at rest for at least a week. It was a common observation during the war that many of the wounded, especially those with fractures, who were transported great distances before proper surgical measures could be taken, suffered from pulmonary fat embolism. I noticed this complication particularly in one location. In the exigency of war two armies were placed side by side. The ambulance corps was just behind, drawing wounded from each. One army had ample splints to use, the other had none. Almost without exception the patients with non-splinted fractures of large bones were found in very poor condition. The ordinary resuscitation methods aided these patients but little, and even in cases with poorly-splinted fractures the mortality was high. I performed necropsies in eight fatal fracture cases and found an astonishing amount of fat in the lungs in all.

The entrance of fat into the previously weakened circulation tends further to weaken it. When fat enters the venous circulation the venous pressure is increased and the arterial pressure decreased, consequently the blood flows at a slower rate. As has been shown by various writers<sup>1, 12</sup> when free liquid



fat enters the venous circulation, most of it collects in the pulmonary capillaries. If there is incomplete aëration of the lung by shallow respiration, the free liquid fat tends to remain there and more collects as it enters the pulmonary circulation.

*Symptoms.*—There are two types of symptoms, pulmonary and cerebral. They may appear singly or in combination. In the pulmonary type the respiratory rate is increased and shallow; dyspnoea soon develops, followed by cough and cyanosis; expectoration may be present and there may be blood in the sputum. The pulse-rate is increased, and the pressure is low. The radial pulse is very small in a great many cases. These symptoms may come on exceedingly fast. In one case reported by Bissell the respiratory symptoms began to appear during operation. The amount of liquid fat liberated into the blood-stream seems to determine the suddenness of symptoms. There is a type of case in which the symptoms are dormant or absent for a time; later the respiratory symptoms appear. These may appear, then partly or wholly disappear, and reappear again in from five to twelve days with fatal result.<sup>1</sup> This is explained as being due to fat passing through the pulmonary circulation into the general circulation and again collecting in the pulmonary capillaries.

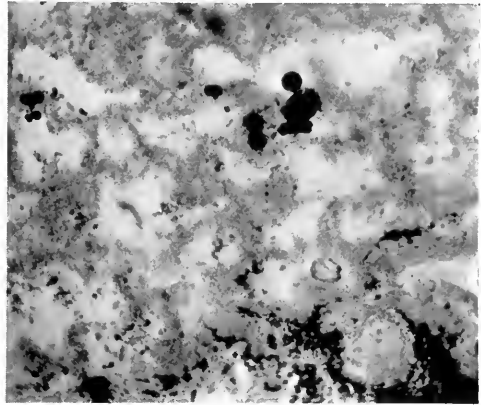


FIG. 3.—(Case A181050). Showers of small fat droplets filling the capillaries of the lung. The larger vessels are quite filled with fat. (x 50.)

The temperature is of two types: In a case confounded with shock the temperature is normal or subnormal, and the skin and mucous membrane are blanched or ashen. In the majority of cases the temperature is elevated; in fact, it is quite the exception to have a normal or subnormal temperature. In only two of the fatal cases in the Mayo Clinic since 1916 has the temperature been normal. Often there is a sudden elevation of temperature before death. If there is bloody expectoration it is explained by the rupture of some of the capillaries of the lung. This produces hemorrhages into the bronchial tree, which are similar to the patches on the surface of the lung in the form of small petechial hemorrhages.

When the fat passes through the pulmonary system and out into the general circulation the central nervous system may receive an overwhelming amount in the form of emboli. A chain of cerebral symptoms follow, ushered in by restlessness, headache, uneasiness, mental dullness, stupor, and delirium. The delirium may vary from a mild type to a very disturbed state accompanied by hallucination. The reflexes are dulled and tremor, convulsions, and

paralysis have been reported. When the cerebral symptoms are predominant the diagnosis is often confounded with delirium tremens. The cerebral symptoms usually appear following the pulmonary symptoms, as a rule, from two to eight days following injury.<sup>1, 4, 7</sup>

Helpful aids to the diagnosis of fat embolism are the discovery of pulmonary oedema, invariably found on examination of the chest, signs of bronchopneumonia at the bases, with the right ventricle dilated, small petechial hemorrhages in the skin over the chest, and blood-stained sputum containing numerous fat droplets. Fat droplets appearing early in the sputum is one of the newer signs of pulmonary fat embolism and should not be overlooked. Warthin found them the second day after injury. At necropsy the droplets may be found in the mucous exudate of the trachea and large bronchi. Associated

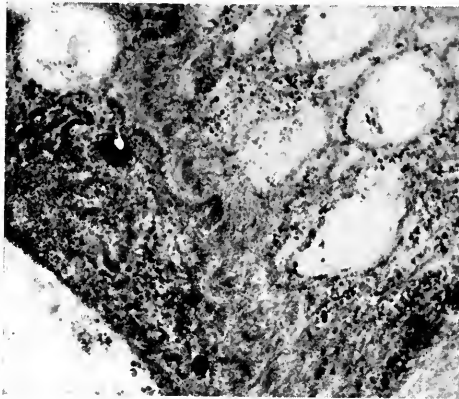


FIG. 4.—(Case A185831). Showers of fat droplets in capillaries and larger vessels of lung and numerous fat droplets in alveoli. (x 50.)

with the fat droplets in the sputum there may be alveolar cells and phagocytes containing fat droplets. Globules of fat may be present in the urine. They are easily detected on the surface if the urine is held up to the light. The lipuria may appear at once; it usually appears at some time during the complication, but death from fat embolism may occur without lipuria. This is explained by retention by the lung tissue of sufficient fat to cause death without free fat being forced into the general circulation. Besides lipuria, there may be casts; certain observers

report the presence of brownish casts.<sup>9</sup> In some instances free fat may be obtained from the general circulation by vena puncture.<sup>12</sup> By examination of the eye grounds fat may be seen circulating in the retinal vessels.<sup>3</sup>

In explaining the difference between pulmonary fat embolism and shock many observers assert that there is a quiescent period in pulmonary fat embolism before symptoms appear.<sup>5</sup> This is true in some instances, but in others the symptoms and signs may appear during operation or immediately following injury.

*Pathology.*—Lipæmia, with a subsequent distribution to the tissues, principally the lung, of emboli of liquid fat, is the first pathologic change observed. This takes on the rôle of infarction in the tissues of the body when it leaves the lungs. These infarctions go through the same pathologic change as that of an infarct in the same tissue caused by any foreign material. A wound in the fatty tissue, filled or partly filled with a blood clot and loaded with free fat droplets, would seem to be an ideal way of feeding the venous

system with fat. If the area is rich in fat, more fat can be distributed to the blood.

The capillaries of the lungs are filled with fat droplets. Fat may be present in the small veins of the tissue of the lung and free fat droplets may be seen in the trachea, large bronchi and, in some instances, in the smaller bronchi. Often the capillaries of the lungs are ruptured, allowing the escape of the fatty foreign material with localized small areas of hemorrhage. This is particularly noticeable on the surface of the lung where small petechial hemorrhages are seen, which may be red or rusty brown in color, depending on the age of the hemorrhage. The lung shows considerable engorgement of blood. *Cedema*, localized or quite general, is present and usually broncho-pneumonia in the lower lobes. When the lung tissue is cut, fat droplets are seen on the blood that runs from the cut surface. The liver, spleen, heart and adrenals show fatty infarction with fatty degeneration of the tissue involved.<sup>12</sup> Grossly the kidneys show congestion; staining shows fat emboli in the capillaries. This is partially true of the capillaries of the glomeruli where showers of fat are to be seen. Accompanying the fat in the capillaries of the glomeruli there may be areas of hemorrhage.

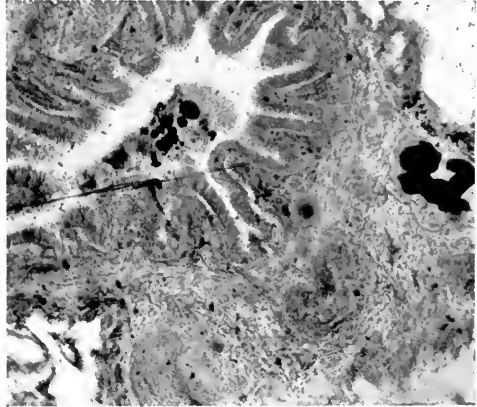


FIG. 5.—(Case A191362). Large vessels and capillaries contain fat. Fat droplets are also in the exudate of the bronchus. (x 50.)

*Involvement of the Nervous System.*—It is the consensus of opinion that the involvement of the nervous system is a later phase of pulmonary fat embolism.<sup>1</sup> There is no particular part of the central nervous system where fat emboli have not been found. Fat is present in the retinal vessels, in the capillaries of the gray and white matter, and in the capillaries of the cord. It is often seen in the perivascular spaces of the vessels in the central nervous system. *Cedema* of the nervous tissue adjacent to the emboli often occurs.

Wilms believes that a considerable quantity of fat in the blood-stream, which subsequently lodges in the lungs and other organs, comes by way of the lymphatics. On this theory he inaugurated treatment by drainage of the thoracic duct in cases of pulmonary fat embolism. The lymphatic system plays a part in the transportation of fat in fat embolism, but it is not the principal channel of transportation. The lymph-nodes adjacent to a wound causing pulmonary fat embolism may not show fat. Experimentally the lymphatics of a leg have been removed as completely as possible, and, after injury to the leg, pulmonary fat embolism occurred.

*Treatment.*—If bones are broken or crushed, the member should be kept

quiet.<sup>2</sup> If transportation is demanded, the fractured member, if it is an extremity, should be put on an extension splint. The use of an Esmarch bandage or a Mombert's belt has been recommended for one-half hour following fractures around the pelvis.<sup>2</sup> Lipoidal solvents in wounds should be avoided. Complete hæmostasis is important, and, in cases in which considerable fatty tissue has been injured, the wound should be drained at its dependent point.

Active treatment has not met with much success. Normal saline injected into the veins has been recommended.<sup>8</sup> Schanz reports good results in the treatment of eight cases by this method. He injects the solution early into

several veins, preferably a large vein. A two per cent. solution of sodium carbonate has been recommended by Czerny; Minich believes this to be useless. Experimentally it does relieve the dyspnoea. Wilms recommends drainage of the thoracic duct and reports success by this treatment in one case.

Because of the extra strain placed on the right side of the heart by the increased resistance in the pulmonary circulation, one should use intravenous medication in small amounts. If large amounts of intravenous solution are to be

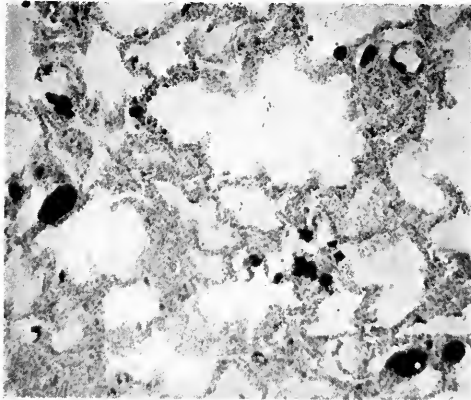


FIG. 6.—(Case A192661). Capillaries and larger vessels filled with fat. (x 50.)

given either in an attempt to dilute the blood or to "fix" the oil, as in the use of sodium carbonate, it would be better to precede such treatment with venesection. Stimulation and supportive treatment should be undertaken. Cardiac stimulants and heat should be applied to keep the blood flowing at as high a rate as can be maintained.

#### DISCUSSION

One outstanding point in the analysis of these cases is that an obese person undergoing a major operation, particularly if it is necessary to destroy fatty tissue, undergoes an added risk. In the greater number of cases the symptoms appear suddenly; they may develop even during the operation. A point of differentiation that has been made between shock and pulmonary fat embolism is that the symptoms of pulmonary fat embolism make their appearance later. This, as shown by the Mayo Clinic series, is not necessarily true.

Death from pulmonary fat embolism is relatively rapid. Most of the patients in the series died on the first, second, or third day after operation. Only one patient lived eleven days; one lived six days.

NOTE: The thesis as submitted contained detailed illustrated reports of sixteen cases including temperature charts. The cases are summarized in the accompanying table.

# PULMONARY FAT EMBOLISM

TABLE I  
*Analysis of Cases in which Death Occurred from Pulmonary Fat Embolism\**

Case	Operation of injury	Age, years	Weight, pounds	Height Feet      Inches	Temperature, degrees	Pulse	Onset of symptoms	Time until death	Clinical diagnosis	Distribution of fat (at necropsy)
A176353	Multiple fractures...	75					At once	2 hours	Shock	Lungs, right side of heart, and inferior vena cava
A176352	Multiple fractures...	44					At once	1 day	Shock	Lungs, pulmonary artery, and inferior vena cava
A179570	Multiple fractures...	28			99	140	1 day	3 days	Shock	Lungs and inferior vena cava
A181050	Partial thyroidectomy	42	278	6      1	99-101.5	80-100	At once	6 days	Cardiac dilation	Lungs
A186135	Laminectomy...	31	142	5      6	103.8	135	1 day	2 days	Meningitis	Lungs
A185831	Inguinal hernia...		175	5      3	103.5	100-140	At once	1 day	Intestinal obstruction	Lungs
A191362	Ventral hernia...	67	160	5      8	100-102	80-120	2 days	11 days	Pneumonia	Lungs
A192661	Umbilical hernia...	53	225	5      3	100-101	100-130	2 days	6 days	Pulmonary embolism	Lungs, inferior vena cava, and aorta
A193911	Cholecystectomy		Obese					15 hours	Shock	Lungs
A212639	Fracture.....	9			102	130	At once	8 hours	Shock	Lungs
A202195	Total abdominal hysterectomy	50	147	5      3	105	120	At once	20 hours	Shock	Lungs, mucus of trachea, and bronchi
A202891	Total abdominal hysterectomy	52	200	5      7	103.8	120	8 hours	5 days		Lungs, inferior vena cava, and portal vein
A108053	Ventral hernia.....				99-100	99-126	12 hours	2 days	Pulmonary fat embolism	Lungs, mucus of trachea, and bronchi
A268997	Tumor of the thigh..	59			101-102	100-120	12 hours	3 days	Pulmonary fat embolism	Lungs
A265230	Cholecystectomy....	59	160		98.5	90-120	During operation	12 hours	Cardiac insufficiency	Lungs, right side of heart and pulmonary artery
A168252	Post-operative ventral hernia	60	229		99-100	130	8 hours	3 days	Pulmonary embolism	Lungs

\* These cases date from the year 1916, and do not include the three cases reported by Bissell in 1917.

A positive diagnosis was made in four cases. In one (Case A202195) the surgeon inserted a glass tube with gauze into the wound, hoping to prevent the absorption of fat. The patient died in twenty hours of pulmonary fat embolism.

The temperature was elevated in all cases.

All of the cases in the series, and the three reported by Bissell, were proved by necropsy. Necropsy was not permitted in two other cases in which all the clinical symptoms pointed to pulmonary fat embolism.

Stimulative treatment, and normal saline intravenously, seemed to have little effect.

Pulmonary fat embolism should be taken into consideration as a compli-

cation in any surgical case in which there is a destruction of fatty tissue and in which there are symptoms of cyanosis, rapid or labored respiration with or without cough, elevated temperature, and an increased pulse with a low tension. The sputum, urine, and the eye grounds should be investigated for fat.

#### ILLUSTRATIVE CASES

The following illustrations are presented in order to show that post-operative lipæmia and pulmonary fat embolism are frequently post-operative complica-

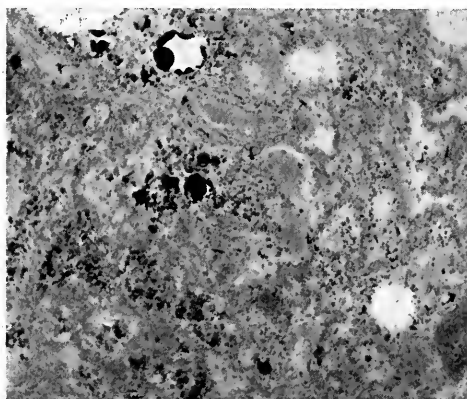


FIG. 7.—(Case A212639). Showers of small fat droplets in the lung capillaries and mucous exudate of alveoli. The large sized vessels are filled with fat. (x 50.)

tions, and that they are not caused by a mass of fat in the heart or its adjacent large blood-vessels, as is generally believed.

**CASE I (A176353).**—A man, aged seventy-five years, was brought to the hospital *in extremis* after being transported thirty-five miles by rail from the scene of a railroad accident. Death occurred two hours later.

Necropsy revealed, besides multiple fractures of the bones of the body, a large amount of liquid fat in the inferior vena cava, the right auricle and ventricle, the pulmonary artery, and the lung parenchyma (Fig. 1).

**CASE II (A179570).**—A man, aged twenty-eight years, was operated on for compound fracture of both femurs and the left humerus. Death occurred on the third day.

Necropsy revealed fat droplets running from the cut surface of the lung and in the blood of the inferior vena cava (Fig. 2).

**CASE III (A181050).**—A man, aged forty-two years and weighing 278 pounds, had multiple adenomas of the thyroid. Thyroidectomy was performed. Convalescence was uneventful until the third day when the patient became mentally disturbed and later delirious. Death occurred on the sixth day.

Necropsy revealed a few petechial hemorrhages over the visceral pleura and an unusual amount of blood containing free fat droplets in the lung parenchyma (Fig. 3).

CASE IV (A185831).—A man, aged thirty-one years and weighing 175 pounds, was operated on for left inguinal hernia. Seventeen days later symptoms of obstruction made a second operation necessary, at which a piece of scarred omentum causing obstruction was removed. Death occurred twenty-four hours later.

Necropsy revealed patches of semiconsolidation in the lower lobe of the right lung, intermingled with œdema and large amounts of free fat in large and small globules in the blood of the cut surface of the lung (Fig. 4).

CASE V (A191362).—A man, aged sixty-seven years, weighing 160 pounds, was operated on for post-operative ventral hernia. The hernia was repaired by a plastic operation and a spermatocoele was removed. The symptoms began to appear on the second day with slightly increased temperature and pulse. Moderate cough and a slight amount of bloody sputum were accompanying symptoms on the fourth day. The sputum was negative for tuberculosis bacilli. Death occurred on the eleventh day.

Necropsy revealed pulmonary fat embolism, petechial hemorrhages over the visceral pleura, œdema of the lungs, obliterative fibrous pericarditis, and a large hæmatoma in the operative wound (Fig. 5).

CASE VI (A192661).—A woman, aged fifty-two years, weighing 225 pounds, was operated on for incarcerated umbilical hernia, at which the adherent omentum was separated and a segment of omentum removed. Two days after operation the temperature rose; the pulse remained between 120 and 130 for five days, then increased to 140 on the sixth day, when death occurred.

Necropsy revealed fat droplets in the blood of the aorta and the inferior vena cava. The lungs were hyperæmic and fat droplets were present in the blood from the cut surface (Fig. 6).

CASE VII (A212639).—A boy, aged nine years, was operated on for fracture of the lower end of the right femur with sequestrum. The end of the femur protruded through the scar of the former operation and was necrotic. The granulation tissue was curetted, the skin edges removed for 0.6 cm. around the old infected scar, the ends of the bone were freshened and the epiphysis replaced and held by two nails. The wound was left open. Death occurred eight hours later.

Necropsy revealed large globules of fat in the vessels of the lungs and smaller ones throughout the parenchyma (Fig. 7).

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## SURGICAL TREATMENT OF HEPATIC ABSCESS AND HYDATID CYSTS EVACUATING VIA BRONCHUS

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CASE I.—For some weeks before admission to hospital a young man, aged twenty-eight, had been suffering from what his doctor had diagnosed as “an hydatid cyst which was emptying itself through his lung.” It commenced with an irritable cough which had existed for about one month before he suddenly brought up a large quantity of “pus;”—immediately\* following this he, for the first time, suffered from fever at night, some shivering, much sweating, constant cough, with a large output of “bile.”

When admitted he was emaciated, with a parched tongue, temperature 103°, pulse 120, incessant cough and spitting up purulent offensive bilious matter. I kept him under observation for a few days, but, owing to the perceptible daily increase of septicæmia with loss of strength, I felt it a duty, in scorn of consequence, to give him a chance.

Ether by open method was administered; patient was held supine slightly over the edge of operating table. I endeavored to locate cyst with a long exploring needle (eight punctures) but failed. This was rather disconcerting, and was not alleviated by the anæsthetist, who already had commenced uttering ominous words. However, concluding that the cyst had collapsed and was situated in the upper zone of liver, I adopted a plan which I had devised on a former occasion and found efficacious. Some three inches of the seventh and eighth ribs were excised in the right axillary line, the edges of the pleura were rapidly sewn to the diaphragm, the latter was then divided, and I worked my right index finger up along the superior border of the liver until I came to a dense adhesion between it and the diaphragm. The site of this adhesion was much more forward and internal than I had anticipated, and as, at the moment, the condition of the patient was alarming, I regretted that I had not had the good luck to attack through an anterior thoracotomy.

My assistants, by steady forcible retraction of ribs, afforded me the opportunity to insert the needle into liver substance just beneath the adhesion, and thanks to fortunate harmonious action of needle, knife, index finger and blunt hooks, a large drainage tube was fixed into a small collapsed fetid cavity after I had removed a small gangrenous cyst.

Iodoform gauze was packed around the tube, and as shock was marked, the patient was rapidly returned to his bed, and champagne siphoned into rectum; afterwards enemas of warm saline and brandy, strychnine and pituitary extract were administered freely, plus heat. He recovered after a prolonged convalescence, youth won. The operation was completed in seven minutes—in this instance it seemed as many hours.

CASE II.—T. S. B., aged forty-six, an engineer, was admitted to hospital January 25, 1922. Family history normal. In 1918 he served as a soldier in Northern Nigeria; three months after arrival there he had an attack of “malaria” for which he was detained three weeks in hospital. During the following two months, he had two more attacks of same, and one of dysentery, he was then invalided to England where he remained for nine months during which he put on flesh, felt very fit, without any recurrence of “Lagos troubles.”

In September, 1919, he returned to the Argentine; two and a half months

after arrival he had a severe attack of what was diagnosed as "malaria," commencing with a rigor, nausea, temperature  $104^{\circ}$  and sweating—the nocturnal fever, sweating and nausea, lasted for *six weeks*. At times he felt a dull pain in region below right nipple, without any cough or other sign of lung trouble.

At intervals of "three to four months" he had five similar attacks during the ensuing two years—the fever, sweating, etc., "each lasting for at least four weeks." "He never seemed to pick up in the intervals," and he experienced occasional discomfort in an area "about a hands' breadth below level of right nipple."

Four months previous to admission he felt a sudden lancinating pain in left groin, the limb "immediately became swollen and painful." Diagnosis by his doctor was acute femoral phlebitis, two days later the same occurred on the other side, both legs continued swollen and painful, and he was confined to bed for eleven weeks. Within a few weeks the veins all over abdomen became gradually enlarged. "Thrombosis of both Common Iliac Veins or Inferior Vena Cava."

While still in bed—on December 24, 1921—he was suddenly seized with an acute stabbing pain in right chest with violent spasms of coughing. "After about an hour of this he coughed up a cupful of stuff like gum and about ten minutes later brought up over a cupful and a half of bloody sticky matter." Diagnosis—"Broncho-pneumonia." During the following thirty days he became extremely emaciated, with foul tongue, nocturnal fever, profuse sweating, distressing cough, with copious expectoration of "brownish stuff," and acute pain over upper anterior zone of liver.

I saw him, for the first time, in consultation, on January 25, 1922. The patient's appearance suggested profound toxæmia—pulse 110, temperature  $102^{\circ}$  (morning), dry tongue, incessant harassing cough, accompanied by much grumous ("Anchovy sauce") sputum. Marked upward increase of hepatic dulness, accentuated anteriorly, with diminution of tactile fremitus in front, and, if anything, increase of same posteriorly. Coarse crepitations and moist râles were audible over greater part of right lung. The continuous cough seriously handicapped auscultation.

These symptoms indicated a "broncho-pneumonia," of hepatic origin, without septic pleuritis. I diagnosed hepatic abscess in upper anterior zone endeavoring to empty itself *via* bronchus, and urged immediate operation.

On the following morning, January 26, 1922, ether was cautiously administered by open method, with patient supine on table, the chest was painted with iodine, as dulness was distinct up to level of right nipple, an exploring needle was inserted through fifth intercostal space (directly in line below nipple) and at a comparatively superficial depth the syringe filled up with similar stuff to that which he had been spitting up. Through a transverse incision over three inches of the fifth rib were excised, pleura and diaphragm divided; the upper border of liver was found densely adherent to diaphragm. The needle was again introduced, and at a depth of less than an inch an abscess cavity about size of a tangerine was struck. When this was exposed, examination of its interior by finger revealed a circular opening passing from its upper wall through diaphragm, of a diameter about that of a pen holder, situated on superior border of liver slightly internal to line of nipple, at a distance of an inch and a half from the anterior surface. The operation was completed in nine minutes.

By the third day cough and expectoration had ceased, temperature remained at normal. The man got out of bed February 12th, and was discharged cured on the 18th, 23 days after operation.

Seen July 8, 1922, "Never felt better in my life. I have had no more cough

or malaria, and have gained three stone in weight." He still presents a weird display of superficial abdominal veins, some almost equal saphenous vein in size, but he thinks the oedema of legs following walking is gradually getting less.

I think malaria has been maligned in this case. I have doubts as to its taking any part in the piece. Rightly or wrongly? I attribute the attack of dysentery which he had at Lagos, as responsible for the laying of the germ, which got to active business a few months after his return to Buenos Aires, and which culminated in rupture of a liver abscess into bronchus, December 24, 1921.

These abscesses, including hydatids, which trek through the diaphragm, without causing septic pleuritis, and discharge their contents by mouth are, I find, so frequently situated in the anterior segment of the superior border of the liver that it is imperative to bear this probable location in mind before commencing exploration. Although I had an early experience of this condition—published in the *ANNALS OF SURGERY*, May, 1897, I had been operating some years before I realized its surgical significance, and regret that it took so long to materialize (*British Medical Journal*, January 31, 1914) as more definite knowledge of the position of such lesions would have been helpful in the past.

I wish to impress on all who treat such cases to remember that, as often as not, it is a matter of life or death, and in order to enhance even a decimal chance of escape, it is essential to apply two vital operative maxims—every minute counts—undue exposure of the pleural cavity is fatal, consequently everything possible should be done to make the thoracic opening correspond to the most superficial site of the abscess cavity, in other words, to the point at which it may be most readily gotten at.

It is expecting too much of nature to eliminate a septic deposit handicapped by such drainage and infective difficulties, not to mention the gradual decline of general power of resistance caused by constant absorption of toxins.

It is necessary also to bear in mind that this class of abscess is frequently of small size, and as the contents are spat out, the cavity correspondingly diminishes. I have seen some collapsed, therefore failure with the exploring needle must not deflect, nor indeed defer, further surgical intervention as the chances are preponderant that death will supervene before the septic focus which is, now, being intensified by fresh infection from without, becomes obliterated.

Preliminary exploration with needle, always with the patient just under ether on the operating table, should be first made through (according to upward increase of hepatic dulness) the fourth or fifth intercostal space in right nipple line. If the needle, after various trials, fails to give the clue to the situation of a liver abscess or cyst which is obvious as such from the character of the expectoration, again guided by upward increase in dulness, and with the patient absolutely supine on the operating table, I remove three to four inches of the fifth or sixth rib in right nipple line, instantly incise pleura and diaphragm, and rapidly insert interrupted strong catgut sutures through the edges (*en masse*) of skin, muscle, pleura and diaphragm, and tie

same at once, taking care to leave sufficient room for the next manoeuvre—introduction of right fingers between diaphragm and upper border of liver in search for the adhesion which obviously must exist in every case of hepato-thoracic fistula. The base of the adhesion points the site for the insertion of the exploring needle into liver where, invariably quite adjacent, the abscess cavity will be struck. The knife is passed in alongside of needle—the finger along blade of knife—two blunt hooks along finger—a large silkworm gut wisp inserted and fixed to skin, dressing applied, a pint of champagne siphoned into rectum, and patient hurried off to a warm bed in “the continuous outdoor.”

## TREATMENT OF FRACTURED CLAVICLES

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If meagre literature in recent years may be accepted as an omen, we may reasonably assume that fractured clavicles are of minor importance or that the profession has accepted the treatment to date as adequate.

In this particular portion, if not all, of our country it would seem that (due to the X-ray) the patient is coming to demand in many cases more accurate approximation and more stable fixation than most of us are able to offer with Sayre's, Velpeau's adhesives, staves, Brown's shaped sheet metal, leather, wood, one-stage plaster, or anything short of open mechanical aid.

The treatment naturally depends much in a given case upon the age, appearance, sex, and expectations of the patient.

The muscular laborer cares little for anything save function and his heavy muscles minimize a lumpy bone. The young female, on the other hand, neither wants an unsightly scar nor a prominent callus. Conversely what is good for the comely young woman applies equally well to the muscular male.

Our point of vantage in this condition is based upon the fact that the shoulder joint has little tendency to ankylose or its muscles to fibrose as a result of its loose construction.

Hence our treatment may with reasonable safety rely upon immobilization of this joint in the proper anatomic relation, until our fracture zone is safely consolidated.

Our failures to get sufficient geography in our outer unit are due to the fact that we have thus far obtained a poor holding surface for this unit and have in addition not established a permanent base from which to work.

The problem is then, as I view it, to build a solid, dependable foundation around the chest, another movable unit around the arm, and, after completion of these two, to facilitate accurate and satisfactory relationship between the two units and maintain it with a structure equally strong and dependable.

Plaster-of-Paris offers the only workable substance to my knowledge.

In the beginning, attempts were made to hold the clavicle in apposition with a one-stage plaster coat, arm to above elbow, to base of neck on injured side, to three inches below nipple lines. (See diagrams.) This was found to be a tiresome effort laden with uncertainty. I never succeeded in getting satisfactory accuracy by this method and resorted to bisecting the case at a line which would about correspond to the shoulder sleeve seam in a coat. This was a troublesome procedure and was later modified to a two-stage method. In this the body case and arm case were applied separately. (See diagram.) When the plaster was properly set, either at the time, if the plaster was quick, or the next day if it seemed a trifle amorphous, with the body case as a base and a stable foundation, the arm and shoulder joint carrying the

outer clavicular fragment was extended (with counter-pressure against the chest case) outward, upward, backward. (It sometimes facilitates placing the outer unit, to cut a gap in the thoracic case over the acromion and inward to the point of fracture, wide enough to allow free elevation of the shoulder, but always leaving a wide shoulder strap of plaster over the shoulder and inner fragment at the base of the neck.)

When the outer fragment is properly extended, elevated, and placed (inner fragment may be manipulated under the case), a wiped joint of plaster-

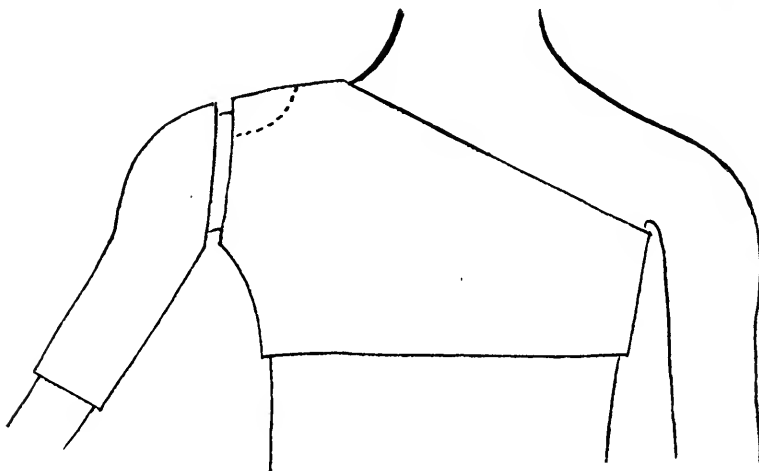


FIG. 1.—The two sections of the plaster casing.

of-Paris is applied around the gap between the body and arm case and this position scrupulously maintained until the extension ring or wiped joint has thoroughly set. Slight abduction of the arm fifteen to twenty-five degrees facilitates placing the circular plaster which of course covers ample chest, axillary and inner arm padding.

In passing it may be mentioned that this same device has answered most happily in a few very painful acromic clavicular luxations and in one, a double-ended clavicular luxation that had proven so painful for some weeks that open operation was asked for. The relief from this device was so immediate and so satisfactory that the patient went to duty in a week wearing the case and wore it for some three weeks longer.

In applying the case I like to smother the patient in sheet wadding, not too thick but wide of the mark with abundant thickness over axilla and inner side of arm. The first layer of plaster is then put on very smoothly and snugly as to the chest, not tightly around the arm. Five to seven thicknesses are ample. When arm case and chest case are sufficiently strong, extension is almost startling. This is due in a measure to the fact that the chest portion recedes against the chest wall and the arm case becomes eccentric due to the outward pull.

I have used this device now in five cases, one a neurotic female, one a

small active boy of nine, one a female, age sixty, one a very muscular teamster, one an ununited of one year from a gunshot wound. All of these cases except the last had been bound for some time in bandages, adhesive, pads, slings of varying design and thickness, and all these fractures overrode decidedly up to two centimetres. All these patients agreed most emphatically that discomfort was practically negligible, that they could jam through crowds without pain, could sleep in any position without discomfort and above all could use the forearm throughout. In all of these five cases no forearm anæ-

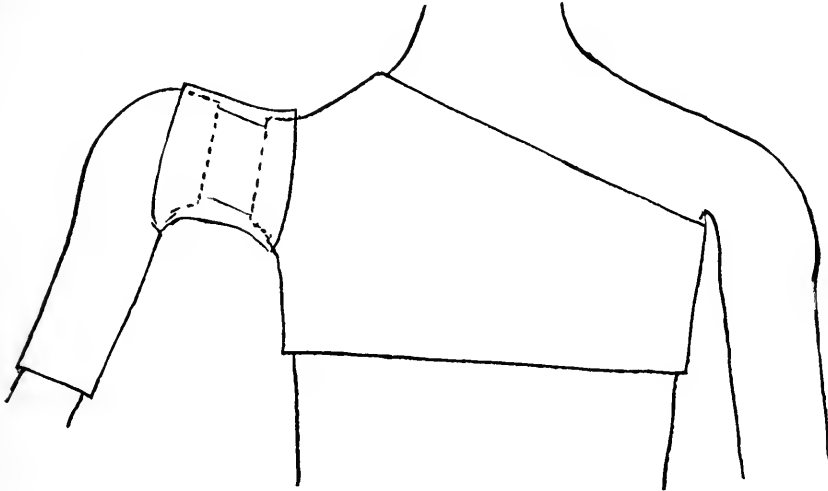


FIG. 2.—The third plaster section securing the bone fragments in position.

thesias developed. No œdema of the extremity, no atrophy of forearm and practically none of arm, due no doubt to the wide excursion permitted the triceps and biceps through full forearm mobilization.

In the fifth case, an ununited clavicle of one year, a small ox-bone intramedullary with a Delangeniére, gave surprisingly rapid consolidation. In this case a port was cut over the incision to facilitate dressing. This can be accomplished down in front parallel with the clavicle, leaving intact the shoulder cap (on top) which maintains all the required points of support and does not weaken the case appreciably.

It might also be mentioned that several types of parallel barred wooden splints, an Armor splint adjustable after the Brown type, and a molded A type were used without success.

The Armor type of pressed adjustable metal is cumbersome, complicated and expensive. The wooden bars and cross-arms require a lot of rigging, and none or all of them answered the requirements of lightness, cheapness, comfort, freedom of forearm excursions, permanency of immobilization and readiness at all times.

Always an infrequent user of plaster and a believer in mobilization wherever half possible, a follower of Lucas Championnière, Willems, Hey Groves,

and Mennel, it required some little denial to mold one's ideas to this rigid looking casing. After a few trials, even of the more crude earlier models, the dependability of the thing and its freedom from constant tinkering and makeshift changes brought home its advantages.

When thoroughly hardened, half-inch holes may be bored promiscuously all over and through this shell and ventilation established through the lining.

It is a good practice also to dry the case as it goes into an electric portable hot-air blower, manipulated by an attendant. This seems to make for a tougher case and a more sanitary interior.



## COMPRESSION FRACTURES OF THE LOWER END OF THE RADIUS

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THERE are few points in the technic of reduction of Colles fracture of the wrist which we call compression fractures of the lower end of the radius which have not been touched upon by some author since the classical description of this injury by Colles. In an article of ours, in the *ANNALS OF SURGERY* for 1920, we proved that there was a great misconception on the part of the profession regarding the question of impaction in these fractures. We proved that impaction, if by impaction we mean any considerable amount of telescoping, does not exist, but that the real pathology consists of a crumpling up of the posterior cortical surface of radial bone; a crush—a collapse which permits perpetuation of the reversal of angle as we call it, or reversal of the plane of the inferior radial articular surface.

The ordinary fracture of this type without displacement of the fragments and without the evidence of great compression which has been wrongly called impaction by most authors, is not a fracture of great importance if properly treated, although the end results if improperly treated, or as at present treated, are about the same as the more serious type so far as restriction of flexion at the wrist is concerned. This, however, has been the result of immobilization for weeks at a time and would never have resulted in a restriction of motion had they been treated by immediate mobilization. In other words, the bad repute of these fractures at the lower end of the radius has been the result of the treatment and not the result of the fracture.

There is the other type, however, showing clearly the effect of a tremendous compression. The distal fragment is displaced backward and the so-called impaction is clearly in evidence.

With this fracture, which we have contended should be called compression fracture of the lower end of the radius, there is always (in the major cases) this crushing or crumpling up of the cortical bone, exactly as happens in wet timber when subjected to compression. The crushing up is always on the posterior or posterior and external side of the radius, because this is the compression side of the bone undergoing stress, and compression is much greater than tension, so that the bone instead of breaking in tension as in a cross-breaking strain, breaks always in compression and results in this crumpling up which changes the angle of the articulation.

If an X-ray plate of these cases is taken after reduction, although the fragments are perfectly movable under the fingers, the reduction having been easy, nevertheless the X-ray clearly demonstrates that the reversal of the antero-posterior angle or plane of the inferior articular surface of the radius

which is normally between fourteen and twenty-two degrees in front of a line erected at the level of the anterior edge of the radius, still remains in all the cases of the serious type. In other words, the antero-posterior plane of the radial articulation had been reversed and in all of the cases remains reversed, even after reduction.

What do we mean by reversal of the antero-posterior angle? Let us look at the X-ray plate of a lateral view of a normal wrist and draw a line straight down the middle of the shaft of the radius (Fig. 1). At the level of the anterior inferior edge of the radial articular surface, let us erect a perpendicular to this first line and carry it through this line an equal distance posteriorly. We shall find that such a line cuts the posterior surface of the

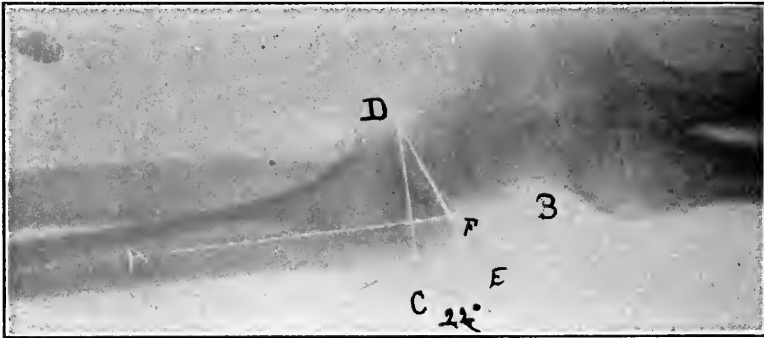


FIG. 1.—The normal antero-posterior angle showing CDE the angle. DE is always in front of DC. The line AB if drawn through the centre will always cut the line DE in the normal bone at a point which will be much nearer to the inferior posterior edge of the articulation F. This is a diagnostic point. Many times as in the above such a line will cut exactly through this point. Where AB cuts DE midway between point D and F it is usually proof of a good deal of displacement. See Figs. 5, 10, 13 and 15.

radius some distance above the articulation. In other words, the normal plane of the articular surface is anterior to this line. Now if we draw another straight line, beginning at the anterior inferior edge of the radius at the same point anteriorly, where we began to erect our perpendicular and draw it just touching the edge of the posterior inferior articular surface of the radius, we shall find that this last line, representing the slant or plane of the inferior radial articular surface will always form an angle with our perpendicular of from fourteen to twenty-two degrees of the arc of a circle and that this angle is always in front of the perpendicular. This, then, is the normal antero-posterior angle of the lower radial articulation and it is usually about eighteen degrees.

The same may be done with the other view, as we have shown before, but that is another matter and has no bearing on the particular point which we wish to make here.

These lines to which we have many times called attention are never absolute, but for practical purposes they will serve, and because they are not absolute, it is necessary that especial care should be taken with the

X-ray plate because, by varying the distance and position of the tube with respect to this lower end of the articulation, we are able to distort our image so as to make it difficult for us to draw conclusions which are accurate. That

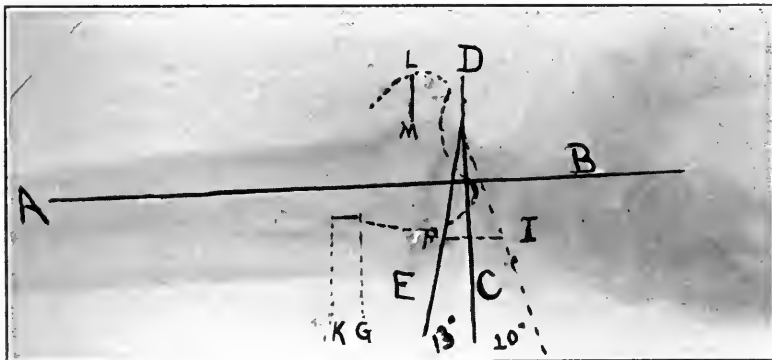


FIG. 2.—Reversal of angle, CDE. Note that the line DE is now behind DC. To estimate its change draw the dotted line in front of DC, at twenty degrees. This will be the plane of a normal restoration and the fragment must be forced forward and upward so that DE will be in front of DC in our final result. The better the restoration the nearer will the line AB come to point F. It will be clearly seen that while DI the dotted line is the plane of the normal joint in this case, it does not mean that the fragment must be forced forward until point F is at point I, because the entire fragment must be lifted up the distance which it has dropped LM. And as the posterior inferior edge F is turned forward a sufficient distance to obliterate the crush K, G, the anterior edge is turned backward an equal distance. The correct position for this case is shown in the outline in dots, of the restoration as it should have been. This is why F, I as drawn for estimate only, is twice K G always. And this explains why we have all of us in the past failed to restore this normal angle. We have been content to unlock the fragment and try to push forward the posterior edge which was equally important and we have failed to lift our fragments enough. Worse than all. Had we succeeded in properly reducing them, we would not have held them with the type of splint which all of us have used.

is the wrist must be taken in a perfect lateral position, the two bones superimposed and the distance from the tube must be always the same. We have suggested a distance of three feet, and the tube must be centred by a plumb-

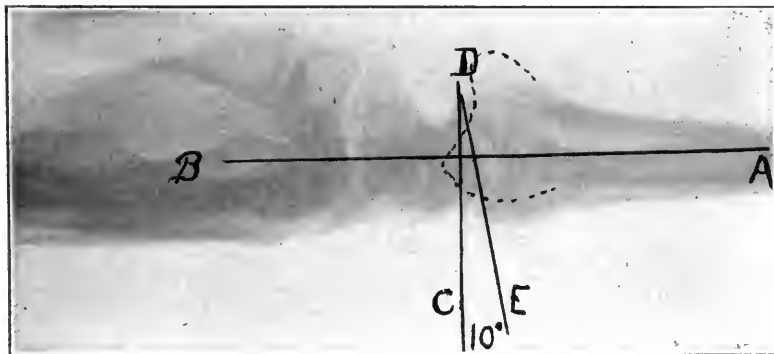


FIG. 3.—Another so-called good reduction and it is true if we judge by the majority. Ten degrees reversal. The dotted lines show where it should really be.

bob over the lower expansion of the radius. If the tube is centred lower down over the hand, we shall have an oblique shadow of the whole radial articular surface thrown on the plate, and this is exactly what we wish to avoid. If we follow instructions carefully in every case, we shall have a

clear picture of the antero-posterior slant of this articulation, and we shall then be able not only to draw conclusions, but to actually measure in centimetres if we so wish the amount of change which we will have to overcome in the reduction of these crush fractures of the lower end of the radius. (See Fig. 2.)

The angle measured in the X-ray plate now shows that it is reversed; in other words, the line representing the plane of the articular surface which in the normal was fourteen to twenty-two degrees in front of the perpendicular line is now behind it, and often an equal distance behind and even after so-called reduction this reversal of angle persists. There has been an actual destruction of bone on the posterior surface of the radius and the

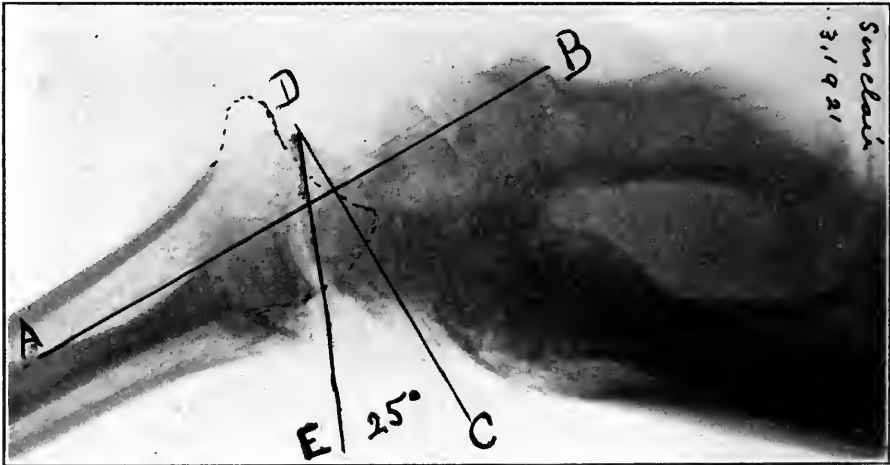


FIG. 4.—Do these cases represent unusual results? Here is another and this one is from a great metropolitan hospital. Would our country cousins do any worse? There are many like this. No attempt was made to better this first reduction. Picture two months after injury, when case was referred to us. Not printed in criticism, but to call attention, that even this type is common and not confined to the small surgeon. We are all vulnerable.

inferior fragment has consequently tipped backward and has been displaced in this direction. It is held rigidly by the bow-string tension of all the extensors, as we pointed out in the article before mentioned. The classical reduction releases the tension of these bow-strings and with comparatively little force the distal fragment can be moved forward approximately into its normal position. The fragment is freely movable. The silver fork deformity has disappeared and apparently there has been a perfect reduction. An X-ray is taken and a good reduction is reported, principally because the shaft of the radius seems to be in fairly good alignment. Little attention in our experience is paid to the fact that there still persists a reversal of the normal antero-posterior angle of the inferior surface of the radius. Now if this were due to impaction, the impaction obviously having been broken up, a freely movable fragment resulting, there would now be no evidence of this so-called impaction.

We have examined a great many X-ray plates of cases treated in the hospitals and outside, by a large number of different operators, and never

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in our experience have we been able to find a case showing this evidence of compression where the normal antero-posterior angle has been restored.

This means, of course, if permitted to remain as it is in every case that I have had occasion to verify, the perpetuation of a certain prominence of



FIG. 5.—Almost reduced. Called a fine reduction and it is reproduced here because it is a better reduction than ninety-eight per cent. of cases. Nevertheless twelve degrees of reversal remains. Why? Because it was not lifted the distance it had dropped, L M. Point D was not pushed back half the distance represented by F I, and point F was not pushed forward an equal distance. The line A B passing nearer to point D than to point F, was enough to show that the reduction was not satisfactory. The dotted outline of bone shows this fragment where it should be if really reduced.

the front of the wrist; of a certain amount of increase in the ability to hyperextend the hand and a certain amount of limitation of motion in flexion even where recovery of motion has been good.



FIG. 6.—The wrench and its method of application used only after fragment is freely movable. It is not often necessary to use it at all. But it is valuable. The hand in this position pushes back the anterior edge of the broken fragment. The posterior prong raises the entire fragment and forces forward the posterior edge and the anterior prong of the lever pushes back the lower end of the upper fragment or shaft now to hold it.

The X-ray man says that the reduction is good, because he never sees any which present any different picture. The surgeon has felt the fragment swing freely into place and he knows that he has reduced it and that if it is freely movable certainly the impaction must have been overcome. For many

years we felt the same way about it. We knew also that with the treatment which we have advocated for many years, that is, mobilization quickly of all these wrist fractures, we could get in nearly every case practically a normal motion at the wrist even with the persistence of this reversal of angle. With immobilization even for three or four weeks of time in these cases, or in any case, there is usually restriction inflexion of the wrist and

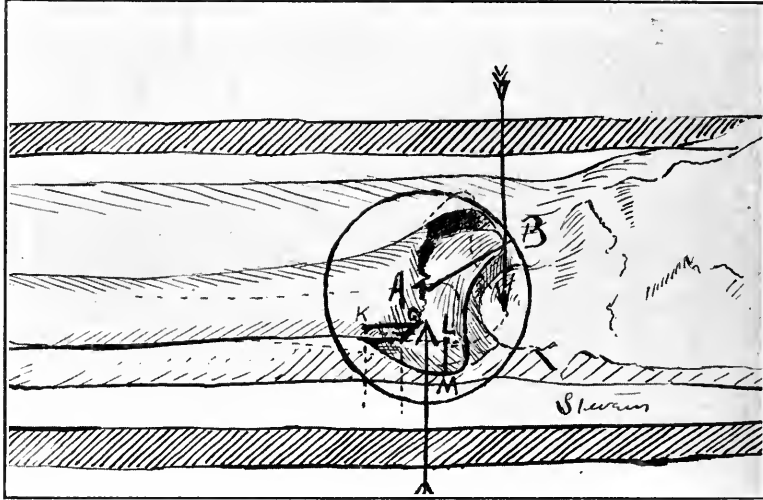


FIG. 7.—Showing the two points of pressure, with long anterior and posterior splints in place. With anterior splint alone the same picture is present, enhanced because the posterior lifting force is removed. Even with padding well back of the fragment there is no force tending to lift the fragment and turn it forward into place. Both these types of dressing tend to perpetuate the reversal. Note how the fragment if considered as a part of a wheel would turn, the posterior part down and back, the anterior down and forward, thus increasing the slant out of all proportion to the compression in evidence. This shows when the apparent crush K G is measured and it is found that twice this distance will be necessary to restore fully the angle. The tremendous distance which the posterior inferior edge of the distal fragment must be swung forward and upward in order to restore the normal plane, it must be remembered, is more apparent than real, because as the posterior edge swings forward and up into replacement, the anterior edge swings backward and upward thus diminishing the distance which the posterior edge would have to move to accomplish full replacement. The fragment must be lifted up the distance it has dropped, L M, the posterior edge turned forward a distance equal to K G, and the anterior edge turned backward an equal distance. Reposition on this basis is outlined in dots to show the correctness of such an hypothesis, the so-called impaction posteriorly being in reality crush. It is clear that after reposition the slightest pressure in a downward direction on B would cause the reversal to reappear.

this restriction persists because the restriction in motion is due to immobilization even more than to a changed articular plane.

It is a rare thing to examine an old case of fracture of the lower end of the radius without finding some restriction of motion, especially in flexion. Ninety out of one hundred cases treated by the old method will show it, and this applies without regard to where the case was treated or who was the attending surgeon. Many times the patient himself is unconscious of this loss of flexion at the wrist; the flexion of the fingers fully compensating for the loss, but if flexion at the wrist is made with the fingers in extension, there will show clearly a distinct loss in flexion.

Only a short time since we were consulted by the head of an insurance

company which specializes in cases of this kind. He had suffered a fracture of this type two years before and had been treated in one of our best institutions. He was not aware of any restriction to flexion at the wrist, and, knowing that I was particularly interested in these cases, he called my attention to the beauty of the result in his case. The flexion of his carpal bones was only forty degrees at the wrist, but as he always flexed his fingers strongly at the same time he was absolutely unconscious of any loss of flexion.

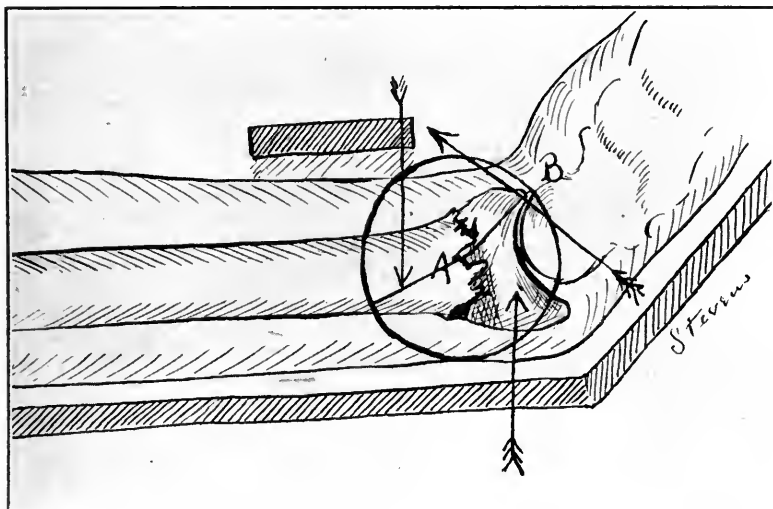


FIG. 8.—Showing the three points of pressure with our angled posterior splint, and a small anterior pad. Imagine the broken inferior fragment, as a part of a wheel, and force applied to its rim in the direction of the three arrows. In what direction would it turn? The radius of our wheel is the line A B and the fragment is not only turned, but is held in place and the reversal of angle overcome. No form of straight splint anterior or posterior will accomplish this, and no form of specially moulded anterior splint alone will do so. The angled posterior splint is the logical solution and the angle is varied to suit the individual case.

It goes without saying that I did not enlighten him because it is our contention that this same restriction of motion is present in the great majority of cases which have been treated by the older conservative methods, without regard to the severity of the injury.

This applies more particularly of course to those cases showing reversal of the angle or plane of the articular surface, which is an important feature in any fracture involving the lower end of the radius, but it does not exist unless there has been a tremendous compression.

Why do these X-rays after reduction with the anterior and posterior splints, or even with the anterior splint alone, in position still show reversal? Not occasionally, but all of them. There are two reasons. First, because there is crush, loss of substance of cortical bone on the posterior side of the radius, and therefore a slight pressure anteriorly upon the fragment will always tend to tip the anterior-inferior edge of the radius downward. Second, the straight position of the hand tends to separate more easily the anterior surface of the break and to push backward the posterior surface, thus perpetuating the reversal, or even recreating it. The anterior-inferior edge

is turned forward an equal distance as the posterior edge is turned backward, and in the horizontal position both are on a lower plane than normal, and this is not restored.

It is not our purpose in this paper to enter into a long discussion of the mechanics or treatment of these fractures at the lower end of the radius, or to deal with the lateral deformity which is overcome with comparative ease, because we have already done that in the article to which we have referred; but we wish to call attention to a method which we have found

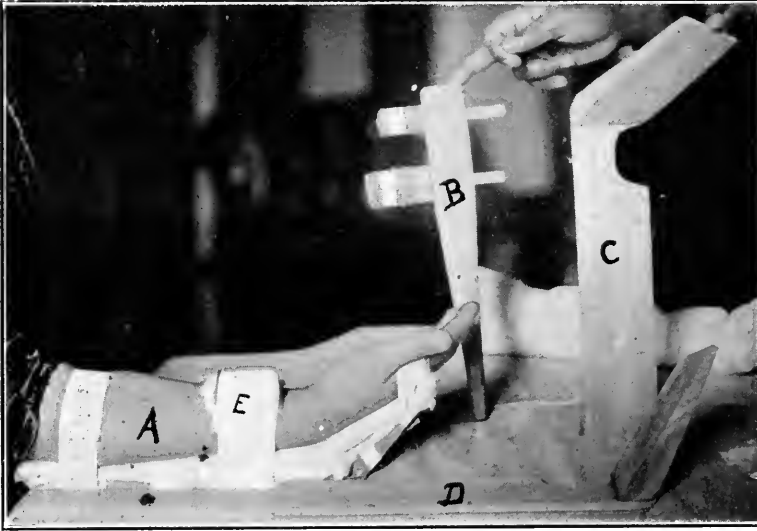


FIG. 9.—A completed dressing without the bandage. B wrench sometimes used. C splint unpadded, forty degree flexion, thirty degree adduction. D splint unpadded, forty-five degree flexion, thirty degree adduction. The splint used here was thirty-five degrees in flexion, thirty degrees adduction. Note the small anterior splint. This shows how simple it is to remove enough dressing for early mobilization and how easy to change the pressure at any time or if necessary to change to a greater or smaller angle. With plaster-of-Paris it is inconvenient and such a dressing has the disadvantage attached to any long anterior splint. A plaster dressing of a radial fracture in flexion and adduction will restore the angle, but it will be much more easily handled by this wooden splint, and the pressure at E can be adjusted as necessary.

valuable in the treatment of those cases of reversal of the angle, which if permitted to remain, means always a slight deformity at the wrist, even in those cases where restoration of motion is good.

There were two statements which we made in regard to this fracture in the ANNALS OF SURGERY for 1920 which we would like to modify slightly. First, we said that the old method of reduction by hyperextension, local pressure downward and forward with the thumb and then strong flexion at the wrist, had not been improved upon in any way. In the ordinary case even with posterior displacement of the inferior fragment where there is little crush, this is an absolutely true statement, but in those cases showing a great deal of crush, and persistence of reversal, we believe that we can overcome this to a great extent, and it is incumbent upon us to work always towards the anatomical normal, because only in this way can we ever attain an absolute



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physiological normality. Good enough is a bad combination. What we want is as near perfection as it is possible to attain.

The unlocking of the inferior fragment of the broken radius is easily accomplished by hyperextension, thus releasing the bow-string tension of the thumb extensors, the extensor carpi radialis longior and breviar, the extensor

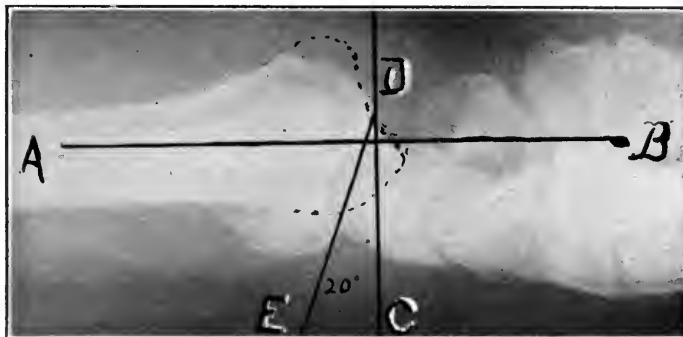


FIG. 10.—Original injury. Twenty degrees of reversal. Dotted outline shows approximate position of normality to be attained in this case. Compare with Fig. 12, showing final result.

indicis and the tendons of the common extensors of the fingers. Local pressure over the fragment with the thumb, traction, and then strong flexion of the wrist with the fingers extended, flexing the wrist to a right angle. I cannot get away from the feeling that this is the important movement in

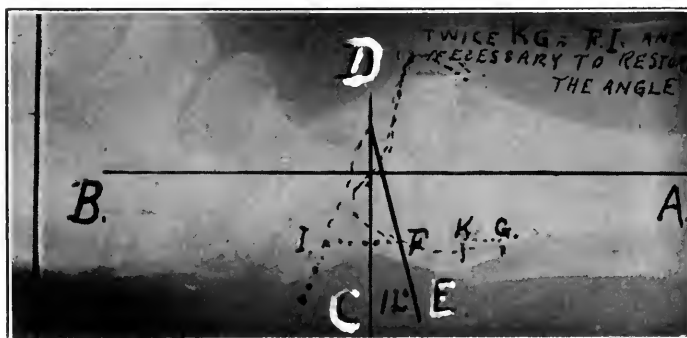


FIG. 11.—Reduction. The fragment is freely movable. The silver fork has disappeared. This was called a good reduction by the X-ray experts and it is such, judged by the usual standards. The angle is still reversed, and is so in any of these cases as ordinarily treated. This applies to large surgical centres and hospitals. In other words they are only half reduced. See Fig. 10 for original injury.

reduction and that flexion afterwards will be exactly proportionate to that degree of flexion which I have attained forcibly at the time of reduction. Circumduction movement is of no importance, but a strong adduction should always be used to reduce lateral displacement and in order to restore the lateral angle which is often disturbed. In the majority of cases this will suffice, for the reduction, but, nevertheless, they will still show the reversal

of the antero-posterior angle, and sometimes to a tremendous extent. While we can return these wrists to practically the normal range of motion, almost as quickly as the apparently much less seriously injured, nevertheless, with this persistence of reversal there must always be at least a slight deformity and a slight limitation.

In the article which we have mentioned several times, we made the statement that by extension and restriction of motion by splinting in a fixed flexed and adducted position over a long period of time, we could restore this angle, but that such a restriction would be followed by a greater disability to the injured wrist than if treated otherwise, because the main requisite of all these



FIG. 12.—Restoration of the angle to twelve degrees, by flexing and using our post-angled splint. Note that there is only a 2 x 2 inch anterior splint and that it is well proximal to the fragment so that no pressure is on the anterior side of the fragment. Note how the crush so prominent in Figs. 10 and 11 has been straightened. Position was all that was necessary. The lever was not used. Angled splint still in place. Fig. 10 shows the injury. Fig. 11 shows the reduction with straight splint in place.

injured wrists is motion quickly. If he gets that, we shall have a return to practically a normal mobility at the wrist very quickly, and, after all, the main desideratum in all these injuries is recovery of motion. A little deformity is not of great importance, except to a woman, but a loss of motion is a calamity. Were we to have our choice between the two, we should always sacrifice looks for mobility. Is it not possible to accomplish both of these much-to-be desired results? The logical position after the reduction of fracture at the lower end of the radius is flexion in adduction; and while we have repeatedly stated this, we have only comparatively recently resorted to it in these cases of reversal. In the cases without reversal, it is not a necessity. We said in our previous article that almost any splint would suffice, and it is a true statement in those cases which do not show this reversal, but we have proven to our own minds, that it is not a true statement in those cases where the angle is reversed. To-day we do not use a long anterior splint at all. A small piece of splint wood two by two inches, which is placed on the anterior surface of the wrist and which must be placed well above the distal fragment so as not to bring pressure upon it in any way, is the only form of anterior splint which is of value. Pilcher, in a most able article several years ago, called attention to the danger of a long

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anterior splint and to the careful padding necessary to prevent pressure on this fragment by the anterior splint, especially in those cases of posterior displacement of the inferior fragment of the radius. If you will look at Fig. 7 you will see how with such a fracture the tendency to backward displacement of the distal fragment is accentuated, unless one is particularly careful, and an anterior long splint will exert pressure upon the lower anterior end of such a fragment tending to perpetuate its displacement, with the resulting perpetuation of the reversal of angle or even tending to renew such a displacement once it has been reduced. Apparently very few in the profession saw the great desirability of avoiding this pressure. We hold that it is not

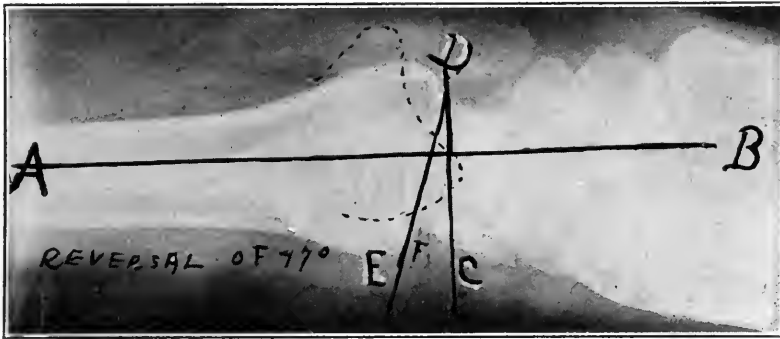


FIG. 13.—Reversal of seventeen degrees after the reduction which was called good. AB much nearer to D than to F. Dotted lines show approximate normal which should have been attained or at least striven to attain.

possible to avoid this entirely, except by discarding the long anterior splint and this applies to all types of long anterior splints.

This type of splint is not only not a necessity, but in all cases of reversed angle it is a distinct menace. There are no advantages in any case, and their use is fraught with danger in those cases where there is the evidence of great compression and posterior displacement of the inferior radial fragment. In the simple cases, therefore, a posterior splint well padded with a large ulnar cut out to prevent pressure on the head of the ulna and a small anterior splint two by two inches, which is placed well back of the large bony prominence of the radius. If placed over the fragment, it perpetuates the deformity. If placed properly well back of the radial prominence, it tends to push backward the proximal end of the broken radius, while the posterior splint tends to push forward the lower fragment. Where there is no need of any correction, the anterior splint is of no value anyway and may be discarded, and this is advantageous because by the use of plaster without an anterior splint, we can keep the ulna more firmly against the lower end of the radius and aid in the restoration of these inferior radio-ulnar ligaments which are always damaged. This pressure tends also to push backward the ulnar head which is normally posterior and thus preserve the normal ulnar prominence.

In the cases with reversal of the angle, what shall we do? If we carry

the hand into extreme flexion and adduction and hold it in that position while we take an X-ray, we shall find that much of this reversal of angle has disappeared. The problem then is to hold it there, and since if we use a straight posterior splint as before in this case, we must of necessity straighten the hand and thus permit the sinking backward of this distal fragment to a certain extent. We cannot do it. Any type of long anterior splint simply accentuates the recurrence. These cases with reversal of the angle are seldom more than half reduced. They must be levered upward to straighten out the crush and force them into position anteriorly. And this is what we do when we forcibly flex the hand. Now we must hold it (Fig. 8). As we

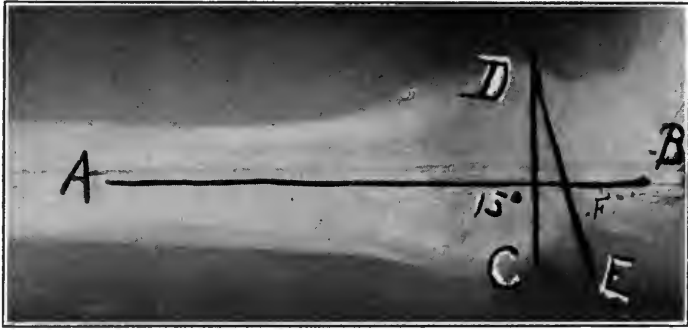


FIG. 14.—Restoration to fifteen degrees. F is nearer the line A B than D. This fragment should have been lifted more.

have said, this crumpling up of the fibre is akin to the compression breaks suffered by wet timber when broken under compression, and that, exactly as in timber, there is destruction of cortex which it is impossible to absolutely restore, but exactly as we can in the straightening of a beam of timber after compression fracture, partially restore it, so to-day we believe that in these cases by the use of a special posterior splint which holds the wrist in a position of flexion and adduction we can do away to a great extent with this reversal of angle without interfering, except to a minor degree with our treatment by early mobilization. Such then is the type of splint which we have devised for all these cases of reversed angle (Fig. 9). The short side of the splint reaches from the wrist to the proximal ends of the phalanges. It is angled at the wrist thirty-five to forty-five degrees in flexion and thirty degrees in adduction. There is an ulnar cut out and the splint is narrower than the wrist.

This prevents the tendency to separate the radius and ulna which is present where wide splints are used, especially when both anterior and posterior splints are employed. Keep the ulna and radius together at their inferior articulation so that the torn inferior radio ulnar ligaments may heal.

We have reduced the fracture, the inferior fragment is freely movable and we have pushed it forward into place. Remember that nearly always the fragment is permitted to remain too far posteriorly. The operator is afraid

of pushing it to the front too far, and therefore often he fails to fully reduce. Push it forward firmly. Flex the hand to the limit at right angle to the wrist. Adduct to the limit to restore the lateral plane of the articulation; mould locally with the fingers, and put on the posterior splint—angled as shown in the illustration. Figure 9 shows the splint applied and study of this illustration will demonstrate the method of application. Take an X-ray, immediately for verification. Where the crumpling up has been tremendous and there is difficulty in reduction, the implement represented in Fig. 9, B, which we use and have found efficient, may be used, but remember that this implement is never to be used until the bow-string tension has

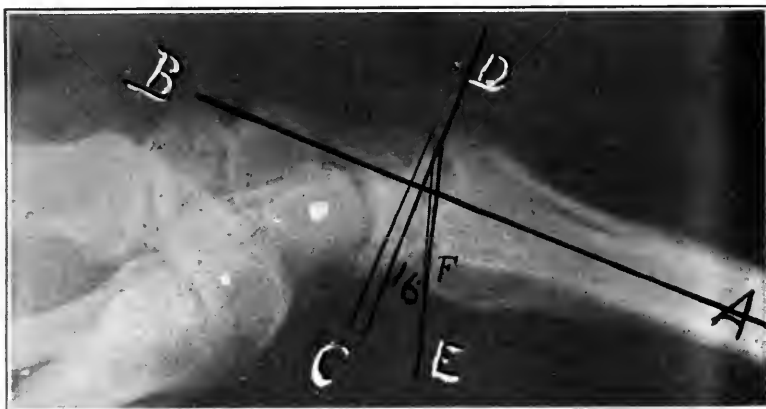


FIG. 15.—The silver fork is obliterated, and reduction was called good but it is not. Sixteen degrees of reversal. Note how the line A B is still nearer to D than to F.

been released. It is the last thing to use in order to obliterate the last vestige of reversal of angle. It is never to be used as an instrument for reducing the fragment. If used in that way, a great deal of damage could be done by accentuating the crushing. The instrument is used exactly as shown in the illustration, Fig. 6, and may also be used for restoring the lateral plane or angle as well. It is applied after the fragment is free, exactly as shown, one prong well padded resting against the inferior fragment posteriorly and one resting against the proximal fragment anteriorly. By leverage gently, but firmly, we can now pry up the posterior surface of the displaced fragment while exerting pressure backward against the proximal shaft of the radius, until the normal prominence of the inferior radial articular surface is restored. Nearly all of these inferior fragments when displaced are only partially replaced, and by this manœuvre of leverage we can force them far forward into position in spite of the posterior crumpling of cortical bone. Do not use too great a force. The leverage stick is only for the unusual case. The usual case can be reduced without it. The crumpled up cortical bone is straightened, but there is always a loss of substance posteriorly, and if now we put on an anterior straight splint, we shall not only not hold the reposition, but we shall

inevitably tilt the fragment backward again to an extent sufficient to recreate the reversal (Fig. 7). Hold the position by the application of the special posterior splint, and place anteriorly a small well-padded strip of wood slightly narrower than the arm at this point, and two inches in length only. Be sure and get this above the lower fragment. If you place it over the normal prominence of the lower end of the radius. Do not expect that you will absolutely restore the normal angle in every case, but you will be able in most of them, to so correct this displacement, that the line representing the plane of the articulation will always be in front of the perpendicular, and if

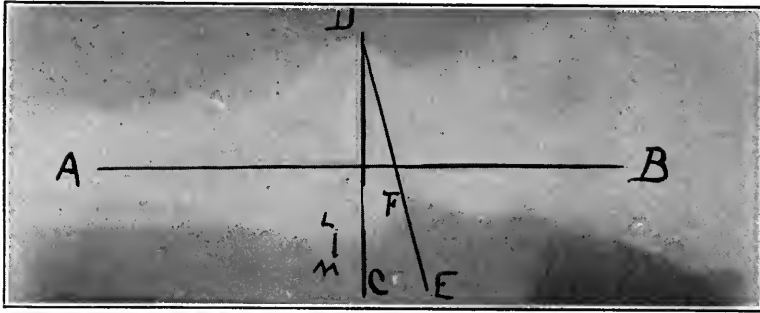


FIG. 16.—This shows what the wrench and angled splint accomplished. Sixteen degrees in front of D C means normality practically. The reversal of this plate is because it was printed from the other side of the film. L M still show the amount of drop which would have meant perfect reposition.

you accomplish this, you will have restored this joint to a practical anatomical normality. If you will glance at the illustrations you will see in Fig. 10 the original injury. Reduction had been attempted and as can be seen had failed. Reversal of the angle is still present; the plane of the inferior articulation is decidedly changed. Figure 11 shows the first reduction by the old method and was called a good reduction by X-ray men who are expert in this line.

Figure 12. The third plate taken shows what was accomplished by the changing of the posterior straight splint for our posterior angled splint. No leverage was necessary. This reduction was accomplished in the service of another surgeon, and the follow-up was not in our hands. It shows a slight spicule of bone anteriorly which is of no importance but which could have been pressed back into place by simple pressure at a subsequent visit. The main point to be observed is that the normal plane of the articular surface of the radius is restored, not to the same extent as before injury, but to a greater extent than we believe possible by any other method. (See Figs. 13, 14, 15 and 16.)

Now the most essential feature of the treatment of a fracture of this type is motion quickly as we have pointed out many times. Shall we jeopardize the position which we have gained in these cases by motion quickly? If this were a fact we should prefer to leave the cases with the angle reversed,

because, even with a reversal of angle, by mobilization quickly, we can restore nearly all of these cases to a practically normal motion at the wrist by the twentieth day. In our first cases, this was exactly what we feared, but we found that our fears were groundless. We must be more careful in instituting passive motion, that is all. Motion is begun in these cases not later than the fourth day, but the posterior splint is left in place during the motion, the hand to the wrist being freed and moved gently in flexion and adduction. Extension in these cases is not carried beyond the posterior splint, until after seven or eight days, and even then the wrist is not extended beyond the horizontal plane for some days longer. By this time there has been a filling in of the posterior gap in the bone by soft callus and it is sufficient to retain the position. Abduction is left to the last. By even a few degrees of motion one can accomplish almost as much as by the fuller arc which is employed in all cases not showing this angle of reversal.

We have repeatedly said that an ordinary fracture of the lower end of the radius with any retention or restriction apparatus after the tenth or twelfth day, except a leather wrist strap was a case maltreated. This is true of nearly all of these cases, but in this type where reversal of angle has been great and we have succeeded in restoring the angle to a practical normality, we have added a few days, and it is usually about twelve to fourteen days before we discard entirely the posterior splint. It is possible that with an increased experience we shall find that we may be able to dispense with it at an earlier date—exactly as we do in those cases which do not present this compression feature. Although we are forced in this type of case to the use of a smaller arc of motion, nevertheless, by the use of that arc of passive and active motion each day, we have preserved the normal ability to flex and extend the wrist and a few days more or less are of little moment in the treatment of this injury. By the twelfth or fourteenth day, these cases have only a leather wrist strap, with an ulnar cut out for protection and their final recovery is no less rapid than the others. From this time on, they use the hand for all ordinary purposes which are not accompanied by strain, but with care and common sense. An individual with a fracture of this type is not expected to throw a base-ball on the twelfth, fifteenth or twenty-first day, and it is not necessary that he should. If he is the type of individual who expects to do these foolish stunts, and there are some who do, or the type who is not intelligent enough to understand the limitations, then he must be restricted for a longer period and so protected against himself. This is unfortunate, but since the passage of the State Compensation Acts have taken away from a certain class of lawyers their ability to blackmail corporations, they have been diligently searching for new fields and the surgical profession has not been overlooked. Therefore, one must be careful, because the medical man may be held responsible for the result of the patient's own folly. A short time since I found a laundry worker who had suffered a fracture of this type and whose wrist I had put into a leather wrist strap on the twelfth day, shaking sheets on the fourteenth day, although she had

been fully instructed as to her limitations, and the foreman of her workroom had also been cautioned as to the exact type of work which she should do. Fortunately no harm resulted, but I was informed that she had insisted on this work on the very day that the retentive splints had been removed. There is, unfortunately, also, in our community, a certain type of medical men, who, slow to learn and adopt anything new themselves, are only too prone to throw all manner of obstruction in the way of others.

Reduce the displacement, begin motion early, and get away from all retentive apparatus as quickly as possible in these joint injuries, and we shall no longer have wrists which show a permanent disability following even the simplest of these compression fractures of the lower end of the radius.

EXPLANATION OF FIGURES

Figure 1: Normal lines of antero-posterior angle.

Figures 3, 4 and 5: Showing reversal and final results in cases of other surgeons and institutions.

Figure 3 and figure 5 were selected because of the excellency of these reductions in comparison with the usual, and because the X-ray men call such a reduction perfect.

Figure 4 was selected for the opposite reason. It is unusually bad as the others are unusually good, yet all are displaced.

Figures 2-10, 11, 13-15: Showing reversal in a few of our cases.

Figures 12-14, 16: Showing correction by our splint and lever.

Figure 9: Picture of splint and method of application.

Figure 6: Showing use of the lever.

Figure 7: Showing danger of anterior splint and mechanics of perpetuation of reversal.

Figure 8: Showing mechanics of correction and showing that when injured, as the posterior portion of the distal fragment turns downward and backward, the anterior portion turns downward and forward an equal distance, so that twice the apparent crush is necessary to completely restore the normal slant. This is accomplished in correction by the pressure of the carpal bones in flexion against the anterior-inferior portion of the distal fragment, forcing that portion backward and upward an equal distance as we turn the posterior portion forward and upward. This is assisted by the pressure of the small anterior splint pressing the inferior portion of the proximal fragment downward at the same time.



## ARTHROPLASTY OF THE ELBOW

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THE mobilization of an ankylosed elbow may be accomplished by simple excision, provided sufficient bone is removed, but such a procedure may render the part weak and unstable. To reconstruct a joint, with a wide range of motion and stability, which will stand the strain of average daily use, is a far more difficult problem. However, unless such a result can be secured a stiff joint in the most useful position is preferable.

In only selected cases should operative procedures for mobilization of an ankylosed joint be considered. The following pathological conditions, which are encountered, decrease the chances of success or actually contraindicate surgical measures:

1. Tuberculosis: In no case should a joint be entered for the purpose of mobilization when tuberculosis was the causative agent in the production of ankylosis. Undoubtedly, it might be possible to obtain excellent results in some instances, but the probability of "lighting up" a latent tubercular process is well known and should be sufficient warning against surgical measures.

2. In those in which a destructive osteitis, in early life, has obliterated the epiphyses a materially shortened extremity is encountered, mobilization of such a joint would not be of sufficient advantage to justify the means.

3. Extensive scar tissue, binding the skin to the bone, may obviously render the procedure unsuitable.

4. Extreme muscular atrophy with reorganization of bone structure, as is

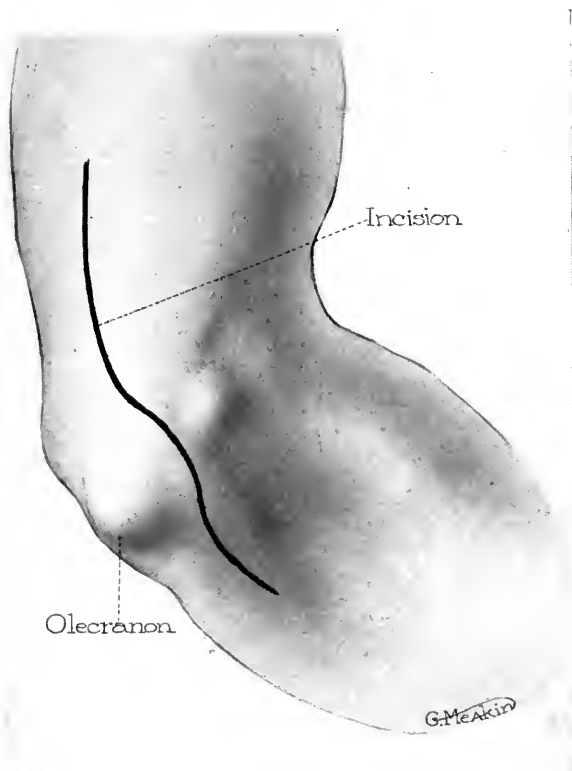


FIG. 1.—External lateral incision for approach to elbow.

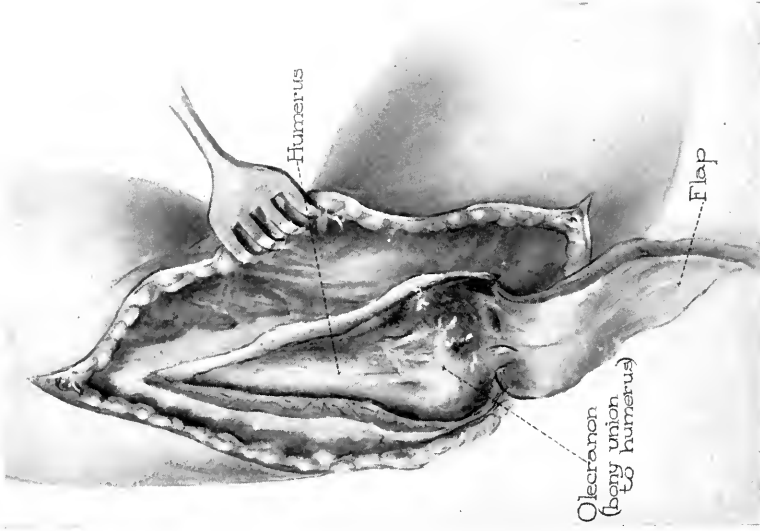


FIG. 3.—Fibres of the triceps muscle through which median incision is made and muscle retracted with periosteum.

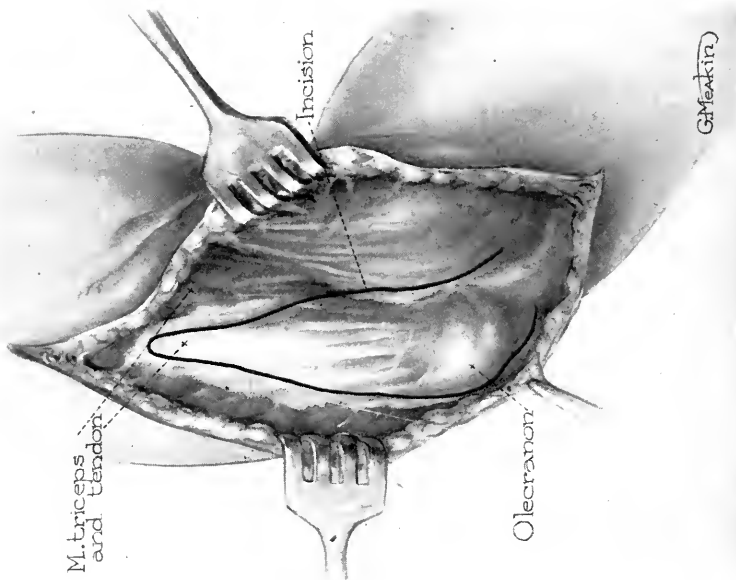


FIG. 2.—Dissection of aponeurotic flaps from posterior aspect of triceps.

seen when a bony ankylosis has existed over a long period of time and the medulla of the humerus and ulna have become continuous through the joint, making one canal from the wrist to the shoulder. In such an instance, which is fortunately rare in the elbow, sufficient base would not be found to reconstruct a functional joint, besides the open medullary canal might be a factor to be considered. The muscular apparatus would also be extremely atrophic and its restoration difficult.

5. Old dense eburnated bone, when found for a considerable distance on both sides of the joint, is not favorable soil for reproduction of a movable joint. Such a condition is usually caused by an extensive virulent osteomyelitis, the result of which is a bone tissue of low grade, bearing the same relation to normal bone that scar tissue does to normal soft tissues. In fact, healthy, spongy bone should compose the articular surfaces of the new joint, consequently, the chance of success is very slight when the structure of the bone has been transformed for one or more inches beyond the joint line.

There are, in reality, only two conditions in which open surgical procedures should be employed in ankylosed joints for the purpose of restoring motion: First, traumatism, causing a crushing of the joint surfaces with tearing of the periosteum or multiple fractures, followed by bony ankylosis. Second, acute infectious arthritis due to staphylococcus, streptococcus, pneumococcus, gonococcus, etc. These organisms erode and disintegrate the cartilages and the superficial bone, unless the infection begins in the shaft and then we have an extensive osteomyelitis and not a localized arthritis.

In no case should this operation be lightly undertaken. The social status, occupation and coöperative intelligence, or "grit" of the patient, must be duly considered. For instance, a young woman applied for treatment with ankylosis of the elbow at about 160 degrees flexion, with the forearm in

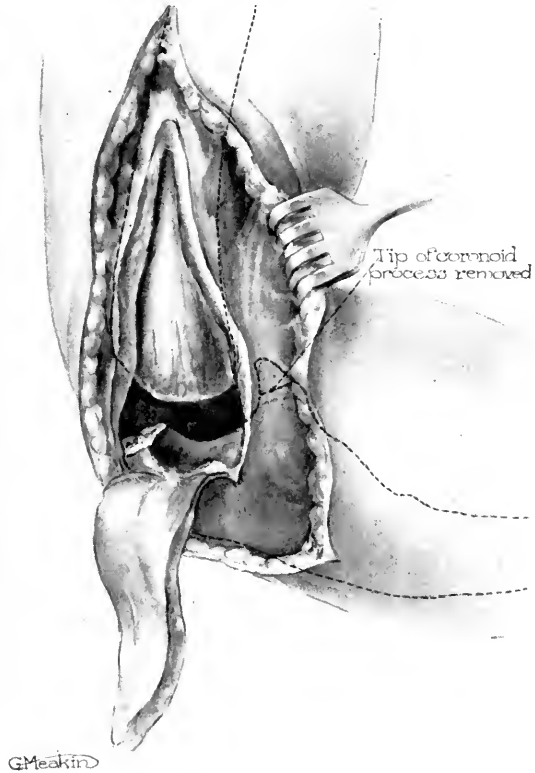


FIG. 4.—Remodeled articular surfaces.

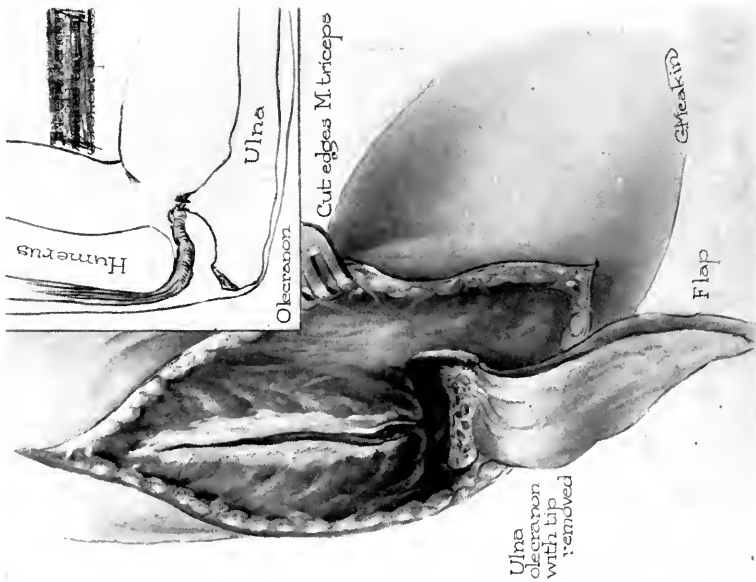


FIG. 5.—Closure of median incision through triceps, with living muscle interposition between joint surfaces, the redundant soft tissues being sutured to anterior capsule, when not available aponeurotic flap is used.

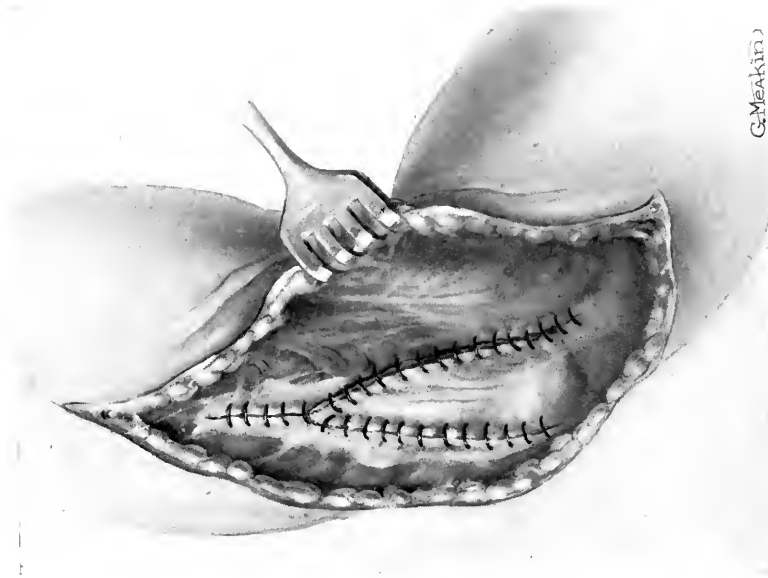


FIG. 6.—Closure of muscle and flap relaxing posterior structures which are often contracted.

pronation. She was a pianist and in her present state able to pursue her vocation. We declined to do the operation, though good function might have been secured, but, even if such was the case, we could hardly be sure of obtaining the required degree of pronation essential to successful performance on the piano.

A chronological survey of surgical procedures for the purpose of mobilization of joints with bony ankylosis has been omitted. However, there are five well-known methods practiced at the present time by various surgeons, as follows:

1. Wide excision of articular surfaces, which usually causes instability and should not be considered.

2. Pedunculated fascial flaps have been extensively employed between the articular surfaces, after remodeling or carving out a new joint. The procedure has been discarded by a majority of experienced operators in this field.

3. Interposition of animal membranes, specially prepared, such as cargin membrane, Baer's pig bladder, Allison's fascia, etc. While successes have been reported, the disadvantage is that foreign body irritation invites infection and the material is often excluded.

4. Transplantation of free fascia lata, extensively used by Putti, of Italy, and Russell MacAusland, of Boston.

5. Mechanical reconstruction of the articular surfaces with removal of sufficient bone to secure mobility without the interposition of any substance.

Recently we have employed a sixth method in elbows, which has been satisfactory in a limited number.

Our technic was evolved from our method for the reduction of old dislocations of the elbow, in which a posterior approach is used, the triceps aponeurosis dissected free, the muscle and the periosteum incised directly



FIG. 7.—Flexion six months after operation for bony ankylosis—arthroplasty.



FIG. 8.—Extension six months after operation for bony ankylosis—arthroplasty.



FIG. 9.—Case II. Showing extension after hemi-arthroplasty.

## ARTHROPLASTY OF THE ELBOW

down to the bone in the midline, and stripped off en masse from the lower end of the humerus. This method gave such an excellent exposure of the elbow-joint and so little damage to those structures vital to the function of the joint, that it was decided to use it as the basis for our arthroplasty operation, the details of which are as follows:

An incision is made, from six to eight inches in length, on the posterior aspect of the arm and forearm, just external to the midline, beginning above, about the middle of the humerus and ending about two or three inches below



FIG. 10.—Case II. Showing flexion after hemi-arthroplasty.

the elbow-joint. Skin, superficial and deep fascia are incised without separation, the deep fascia is dissected laterally, about one inch. This brings the broad aponeurosis of the triceps into view. This structure is dissected from above downward, making a long tongue attached to the tip of the olecranon process below. A further incision in the midline passes through the muscular fibres of the triceps and periosteum to the humerus over the lower half. A periosteal elevator is now used to strip the periosteum from the lower third of the humerus. Scar tissue, callous and loose bony particles are removed. If dislocation exists, reduction is then accomplished without difficulty with periosteal elevator, scoop, or any blunt instrument.

There is no structure of consequence in the line of incision, no danger of vessel and nerve injury if one remains close to the bone; however, if ulnar nerve is exposed it can be isolated and anchored into a position of safety. About one-half to one inch is removed from the lower extremity of the humerus, which is remodeled into a surface convex from before backward, no attempt being made to reproduce trochlea or capitellum. About one-half

inch of bone is removed from the tip of the olecranon process. All scar tissue is dissected from the sigmoid cavity. With a sharp chisel the surface is removed to healthy spongy bone. The radio-ulnar articulation is not disturbed, but the surface of the head of the radius must be made the same level as the coronoid process. A rasp and file render smooth all surfaces. The periosteum and triceps muscle are dissected into a double flap, which is stitched to the anterior capsule, thus separating the raw bony surfaces by a living mass of tissue with abundant blood supply and no risk of pressure necrosis. In those cases where the radio-humeral articulation is normal with bony ankylosis between ulna and humerus, the radio-humeral joint is not destroyed, but a hemi-arthroplasty is done between the humerus and the ulna. In such cases it is not always possible to obtain sufficient posterior flap in lieu of which the aponeurotic broad tongue from the triceps is placed between the surfaces. This structure is also employed when, for any reason, the posterior flap cannot be secured. The capsule of the joint is stitched to the posterior aspect of the triceps muscle and deep fascia, thus closing off the new joint, the wound is then closed in layers with catgut and dermal for the skin.

Full flexion and extension has been secured in one case with no motion in the radio-ulnar joint, but this is well compensated by rotation in elbow and shoulder. The procedure has been employed in a limited number of cases, but sufficient to warrant description in detail. To illustrate the essential facts, two cases are briefly narrated:

CASE I.—Girl, married, age nineteen, acute infectious arthritis of right elbow, six weeks' duration, was seen in consultation with Dr. G. C. Conyers, of this city, October, 1920. Joint at right angles with supination of forearm, acute tenderness and swelling, no hope of mobilization could be offered as X-ray showed complete destruction of articular cartilage, with atrophy and erosion of adjacent bone. No suggestions were offered except to continue splint as acute process was receding. July, 1921, eight months after cessation of acute symptoms, there was no swelling or tenderness, arm and forearm at right angles, no motion apparent. X-ray showed bony ankylosis. July, 1921, operative procedure, above described, was performed with primary union of wound. In three weeks gentle passive motion was given and active motion encouraged by a physiotherapist. This was continued for three weeks, when patient left the city contrary to our instructions, but returned September, 1921, when extension was complete with flexion to 60 degrees. Physiotherapy was again instituted to increase flexion, the result of which is shown in the illustrations.

CASE II.—Man, age fifty, February 3, 1921, sustained a comminuted fracture of the left olecranon and coronoid process, which was followed by solid bony ankylosis between the humerus and ulna. The radio-humeral articulation was free and movable, rotation of the forearm normal, position 90 degrees flexion. October 10, 1921, hemi-arthroplasty of the elbow as above described, interposing triceps aponeurosis; about 50 per cent. of normal motion was obtained within six months.



## ARTHROPLASTY OF THE ELBOW

The after-treatment is very important and must be under the direction of the surgeon with coöperation of a competent physiotherapist. However, active motion is most essential, and can only be done through the voluntary efforts of the individual. In a few elbows and other joints I have seen excellent results by voluntary efforts of the patient, without the aid of anyone, except such instructions as could be given during an office visit, though the average patient will not make the effort without the constant attendance of the gymnast.

Operations for mobilization of joints or arthroplasties are far from 100 per cent. perfect, probably more successful in the elbow than elsewhere. Young adults give the best prognosis, but this is true of all operations. Our oldest case was fifty years of age. In no case has the member been more impaired; our only permanent sequela has been a recurrence of ankylosis, but with larger experience the proportion of success is greater each year, consequently, we believe that joints with ankylosis should be mobilized by operation when feasible.

## THE DIAGNOSIS AND TREATMENT OF INCOMPLETE EPIPHYSEAL FRACTURES AT THE HIP\*

BY ROYAL WHITMAN, M.D.

OF NEW YORK

THE familiar chapter on fracture of the neck of the femur, which has been reproduced in the text-books without essential modification since the days of Sir Astley Cooper, is chiefly concerned with explanations of failure on other grounds than the obvious inadequacy of the treatment to provide the essentials of functional repair. From this standpoint the fracture has always been presented as practically an attribute of old age, induced by local atrophy, indicating faulty nutrition and therefore, the futility and danger of attempting to treat it on surgical principles. In other words, to quote from a leading treatise on fractures, "The ideal object of treatment, restoration of form and function, is rarely to be attempted or even sought."

As a matter of fact the neck of the femur is mechanically a weak point in the skeleton. The fracture is frequent in advanced life because the weak part participating in the general atrophy of old age is subjected to relatively greater strain because of inadequate muscular protection in locomotion.

Contrary to the general impression, however, the aged patients are far exceeded in numbers by those whose physical condition permits efficient treatment now made practicable by the abduction method, and from the therapeutic standpoint the most important cases are those in early life, a class, which has received as yet no adequate representation in the text-books.

Fracture of the neck of the femur during the developmental period may be divided into two distinct classes:

Fracture of the neck proper, and fracture at the epiphyseal junction.

In childhood the fracture is practically always of the neck. It is caused by direct violence, and is similar to the adult form except that it is more often incomplete, the neck having been forced downward and backward, leaving a wedge-shaped interval on the superior surface near the junction with the shaft.

Epiphyseal fracture is extremely uncommon at this age, because the junction is protected by a thick covering of cartilage which becomes progressively thinner as the area of ossification enlarges preparatory to final consolidation.

This fracture, or, as it is sometimes called, epiphyseal slipping, as compared with other fractures, stands in a class by itself. It occurs with rare exceptions only in adolescents.

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\* Read before the New York Surgical Society, May 10, 1922.

## INCOMPLETE EPIPHYSEAL FRACTURES AT THE HIP

It may be immediate and complete as the result of direct violence, but in most instances it is incomplete and presents the characteristics of a progressive deformity rather than those of fracture.

The patient may be in perfect physical condition, but in a certain proportion of the cases is fat and overgrown, presenting the indications of what is called endocrine disturbance, a constitutional predisposition usually present in bilateral cases.

It must be borne in mind, however, that weakness of this character predisposes to all static deformities and to epiphyseal displacement at the hip oftener than elsewhere only because the obliquity of the junction makes it more unstable.

The exciting cause of displacement is apparently a superficial fracture at the superior portion of the junction, or possibly a less direct injury which

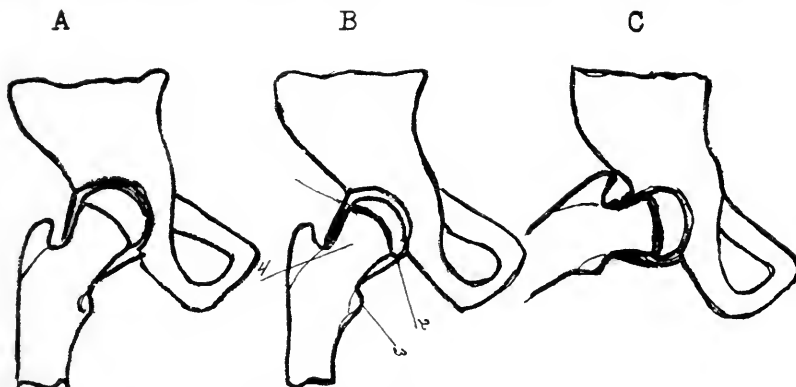


FIG. 1.—A. The normal joint. B. The changes observed in the X-ray picture in the early stage of epiphyseal displacement. 1. The upper border of the head and neck form an unbroken line in the same plane. 2. The lower border of the epiphysis projects downward in its relation to the neck. 3. The epiphysis appears shallower than the normal. 4. The neck appears, because of the outward rotation, shorter and thicker than the normal. C. Shows that in complete abduction pressure is removed from the epiphyseal junction.

weakens the immature bony structure on the diaphyseal side of the cartilage. Then follows gradual downward and backward displacement of the head upon the neck, the rate of progress being determined by the strain or injury to which the weakened tissues are subjected. Thus, under favorable conditions the process of repair may check further deformity, or the weakened junction may give way completely and the lame patient become suddenly disabled.

The clinical history and physical signs in a typical case are as follows: The patient, usually after injury which, however, may pass unnoticed, begins to limp, to complain of occasional stiffness and discomfort at the hip or knee on changing from rest to activity, and of pain after exertion.

These symptoms, usually passing as "rheumatism," persist and increase, often for months, even to the point of practical disability, before the patient comes under observation.

If any treatment is instituted it is usually for "hip disease," the pain, the limitation of motion, and the blurred outline about the cartilage in the X-ray

picture seeming to establish such a diagnosis. Yet, to one familiar with this type of injury the diagnosis is almost self-evident.

The patient is an adolescent, and although he limps, the weight is borne on the entire foot rather than on the toes. There is persistent outward rotation of the limb, which is increased by flexing the thigh; actual shortening is present, but rarely exceeds half an inch; passive movements are restricted to a greater or less degree in flexion, abduction, and inward rotation, while extension, the movement first limited in disease, is actually increased in range.



FIG. 2.—The changes indicated in Fig. 1 are shown in the X-ray picture of the left hip.

In other words, the muscular tension symptomatic of disease, checks all the movements of the joint in fairly equal degree, while in this form of injury they are mechanically accommodated to a head displaced downward and backward upon the neck. In the rapidly progressive stage of deformity, or of secondary fracture, there may be practical fixation by muscular spasm, but in such instances the history, and the attitude of the limb, should make the diagnosis clear.

The X-ray picture is distinctive. Under normal conditions the head rises sharply above the upper border of the neck; in these cases the elevation is lessened and the outline of the head and neck may form an unbroken line.

The epiphysis, as compared with its fellow, seems shallow, an indication of

backward displacement; the epiphyseal junction seems wider, and an actual separation may be present at its upper border. (Fig. 1.)

The increase in width of the epiphyseal area is on the diaphyseal side and apparently indicates softened bone. This is sometimes discovered before the deformity is present, or at least apparent, and the subsequent displacement is attributed to local disease, but since this disease never progresses, and since it disappears after the correction of deformity, it seems more reasonable to ascribe the softening to injury which, although it may precede displacement, is usually coincident with it.

I shall introduce the subject of treatment with the statement that epiphyseal slipping, or epiphyseal coxa vara, or under whatever name it is classified, is, in the great majority, a form of fracture and should be treated as such.

Originally the cases of epiphyseal fracture that came under my observation were invariably of an advanced type, requiring an open operation for the correcting of deformity, as described in former papers. In more recent years, however, I have had the opportunity to treat a number of these patients under more favorable conditions. (Fig. 2.)



FIG. 3.—Epiphyseal displacement in a boy four years of age illustrating the progression of the deformity.

As has been stated, in typical cases the characteristics are those of a progressive deformity, the degree of which is indicated by the restriction of the range of motion. Thus, downward displacement of the head limits abduction, backward displacement limits flexion and inward rotation. Consequently restoration of the normal range in these directions implies the reduction of deformity. The primary indication for treatment, therefore, is to utilize the natural leverage, on which the abduction method is based, to overcome the restriction of motion. (Fig. 3.)

Thus, under anæsthesia, the pelvis having been fixed by abduction of the sound limb, the limb on the injured side is abducted to the degree permitted by the deformity. At this point the upper rim of the acetabulum coming into contact with the neck serves as a fulcrum, and the head being fixed by the tense capsule, further abduction tends to force the extremity of the neck downward into proper relation with the head. (Fig. 4.) This may be accomplished if the progression of deformity has been rapid, or in cases of secondary fracture, although in two cases treated recently it was not until the third attempt that the restriction of the range of motion was overcome, indicating



FIG. 4.—After reduction. Taken through the plaster spica. Contrast with Fig. 3.

the correction of deformity. In cases in which the displacement is too great, or the consolidation too advanced for correction by indirect force, open reduction will be necessary.

The joint is opened by an anterolateral incision exposing the neck, which, in cases of advanced deformity, practically conceals the head. From its extremity a thin section of bone is removed to permit the insertion of the chisel between the two fragments, then by rotation of the limb, and leverage on the instrument, the head is replaced in normal position.

The removal of bone is of little consequence since the epiphyseal cartilage is always a part of the head fragment.

Thus, from the therapeutic standpoint, these patients may be divided into three classes:

*First.* Cases of slight deformity in which it is only necessary to fix the limb in the attitude of abduction for a time sufficient to permit repair.

*Second.* Cases in which the deformity may be corrected by forcible manipulation.

*Third.* Cases in which direct operation is necessary.

As has been stated, the restriction of abduction and inward rotation having been overcome, the limb is fixed by a long spica plaster in complete abduction, and inward rotation, for about three months, or for a period long enough to permit consolidation, during which locomotion may be permitted in suitable cases, since weight is supported by the trochanteric region of the femur. This is followed by exercises to restore muscular power and control, and naturally by general and special supervision and treatment, constitutional and local, as may be indicated. (Fig. 5.)

It must not be assumed that by indirect force an absolutely symmetrical relation between the head and neck is always restored. Nor is this, however desirable, essential to what is practically normal function, as is instanced by the irregularities of the head in congenital dislocation, in coxa plana, and by the various abnormalities of the components of the articulation, that are disclosed by X-ray examination which would otherwise have been unsuspected.

I might suggest in this connection that the removal of pressure from the head by fixing the limb in abduction should be utilized in the treatment of the so-called Legg-Perthes disease in which the influence of pressure tends to flatten the head, rather than to displace it. In such cases, if the pressure were completely relieved the progression of deformity might be checked. This is certainly desirable, for even though the characteristic distortion may cause but little disturbance of function, it may predispose to degenerative changes in later life.

What has been described as an epiphyseal fracture is now usually confused in orthopaedic literature with a group of static deformities under the title of coxa vara.

It seems to me in the interest of clearness of description that coxa vara should be restricted to depression of the neck of the femur as a whole in



FIG. 5.—Ambulation may be permitted in suitable cases of fracture of the neck of the femur in childhood because weight is borne upon the outer border of the neck and trochanter. (See Fig. 1-C.) Figure reproduced from a former paper. (*Medical Record*, March 19, 1904.)

its relation to the shaft. In this sense, like genu varum and valgum, it is essentially a rhachitic deformity of early childhood, and like other so-called static deformities is characteristically bilateral, although not necessarily symmetrical on the two sides. In this typical form of coxa vara of childhood, the head is rarely depressed in its relation to the neck, in fact, the lessened angle tends, apparently, to establish a more horizontal relation at the epiphyseal junction which protects it from displacement. (Fig. 6.)

Bilateral coxa vara in adolescence is, in most instances, a further development of a preëxisting deformity of childhood, a conclusion favored by the



FIG. 6.—Typical rhachitic coxa vara showing the relation of the head and neck as contrasted with epiphyseal fracture.

history, and by the physical evidences of former rhachitis. In this class the more extreme degrees of coxa vara may be combined with deformity at the epiphyseal junction; constitutional weakness, mechanical predisposition, and the added strain of a relatively laborious occupation being the chief etiological factors.

Bilateral epiphyseal deformity distinct from coxa vara also occurs, constitutional predisposition of the endocrine type and injury being

often combined as predisposing and exciting causes.

Since general weakness of structure should cause bilateral deformity, it follows that unilateral coxa vara in childhood, and unilateral epiphyseal displacement in adolescence, are in most instances the direct result of injury.

From the therapeutic standpoint the importance of a clear distinction between coxa vara and epiphyseal displacement is obvious, since in the first instance joint motion is mechanically restricted by a deformity which may be corrected by extra-articular osteotomy. Epiphyseal displacement by contrast disorganizes the joint, and it can be remedied only by intra-articular correction, either indirectly by leverage, or directly by open operation.

It may be noted that mixed types of deformity, usually bilateral, in which epiphyseal displacement is combined with coxa vara, have not been included in this exposition, because it has been my purpose to present a clear outline of a fracture of a peculiar type which is at present rarely recognized, and still more rarely efficiently treated.



## IMMEDIATE OPERATION AS THE METHOD OF CHOICE IN THE TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR

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FRACTURES of the neck of the femur can, for practical purposes, be divided into two very broad groups: (1) those in which the principal plane of fracture is at the base of the neck and lies in close proximity to, or crosses, the intertrochanteric line (Fig. 1); and (2) those in which the principal plane of fracture lies proximal to this general area and lies for all, or its greater, part within the joint capsule (Fig. 2). When there is more than one plane of fracture it is generally found that the various paths along which the comminution takes place have a more or less single direction as determined by the resultant of the various components of the provocative force; the subsidiary lines of fracture arrange themselves in accordance thereto. Insofar as any individual fracture deviates from this definition, or combines certain characteristics of the other group in addition to those essentials of its own, the atypical features determine certain peculiarities in the clinical behavior of the fracture (Fig. 3).

Clinically the cases in group one are distinguished by their ability and readiness to heal under comparatively simple methods of treatment. This is undoubtedly due to the greater possibilities in the way of proper immobilization of the fracture and to the relatively greater blood supply of the area of injury. With this class of fracture there is practically never any difficulty in healing and the period of disability is comparatively short. In the cases in group two the possibilities in properly immobilizing the fracture are not nearly as good as in the other; the period of disability is comparatively much longer; the healing is often tedious and prolonged. The blood supply of the parts is relatively less abundant, and the intra-articular nature of the injury apparently furnishes some agent which interferes with bone production and facilitates bone absorption. All of these factors together explain the frequent failure of the conservative methods of treating the injury. The subsequent part of this communication refers entirely to this variety (group 2) of fracture of the neck of the femur.

In the conservative treatment of the latter class of fracture of the neck of the femur, one is confined essentially to (1) the use of the traction, or (2) to the immobilization of the fracture in plaster. There are a number of modifications of this method: that of Whitman, that of Mixter and that of Moore. Cotton's method of artificial impaction is, practically, a modification of the plaster method also.

The traction method is inefficient and produces the greatest numbers of the failures. Except in certain rare instances its use would not be justified with present-day knowledge.

The use of plaster is more satisfactory. All of the deficiencies of the traction method are either partly or wholly overcome by it. Necessarily its efficient use implies expert orthopædic training and much practice; an adequate knowledge of the anatomical problems involved; the use of an orthopædic table; an anæsthetic; and the proper use of plaster. The abduction method (Whitman) of treating these fractures has been highly recommended.

At the present writing opinion seems to be divided between those who insist absolutely upon the universal applicability of the latter method and its uniformity of success, and those who, having tried the method thoroughly, are not quite so sanguine of success and admit a fair, if not a large, number

of failures. Between the two there seems to be no meeting ground; and the argument of the proponents of the method that the latter had not been properly applied by their antagonists does not seem acceptable in other competent circles. The truth of the matter seems to be that here again, as is so often the case in medicine and surgery, the difference is probably mainly one of nomenclature and depends upon the proper grouping of the fractures as defined in the opening paragraph of this communication; cases in the first group are endowed by their very position with an extreme readi-

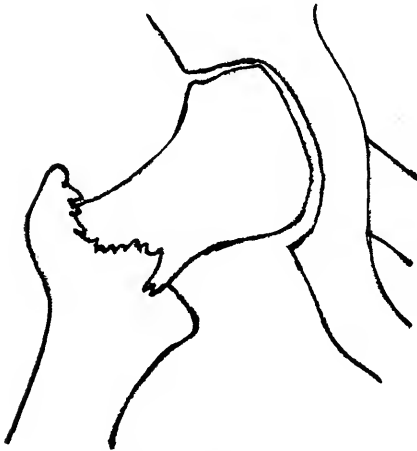


FIG. 1.—The following figures are taken from Cotton, Scudder and Stimson.

ness to heal and serve to explain much of the enthusiasm; cases in the second group are those which furnish the failures under conservative methods and provide the basis for any opposing opinion.

No method of treatment seems applicable when the fracture, as it so often does, occurs in the old and decrepit individual. Here causes not under one's control—the danger of a hypostatic pulmonary congestion especially—force the surgeon's hands and compel a neglect of the fracture in the intense desire to obviate any complication which might cost the patient's life. One must make the best of a bad bargain under such conditions, and the patient must bear with as good a grace as is possible the pain and disability attending the persistence of an unhealed fracture of the neck of the femur.

At the opposite extreme are the fractures occurring in children. With very simple methods of treatment the fractures heal rapidly and excellent results are the rule. No thought of other than the most conservative forms of treatment is permissible.

## FRACTURE OF THE NECK OF THE FEMUR

In between the two—between the old and the very young—are those fractures that occur in adolescence and early middle life, that is in full-grown, robust individuals. Fractures of the neck of the femur are not uncommon in this period and the frequency of the injury in the third and fourth decades of life has come to be well recognized. This is the group that is deserving of most thought. In men of the laboring class, in those who do any hard work, in those who must walk a great deal—salesmen, street-cleaners, policemen—the injury is a most disabling one; the length of time necessary for proper healing in the fortunate ones in whom healing does occur, is most excessive and can ill be spared by those who must earn their livelihood; in those who are not so fortunate and in whom non-union or mal-union occurs, the disability is practically a permanent one and the earning capacity of the individual becomes diminished to the extreme. Anything that will tend to diminish this disability is highly desirable.

In such people as well as in those of the more leisure class an unhealed fracture of the neck of the femur is further disabling because of the annoying pain. This follows walking of any extent, accrues in intensity and becomes practically continuous as the months grow into years, is extremely difficult to relieve by any apparatus, sours the sweetest of dispositions and frequently is sufficient to make life a burden. For those who are fond of the outdoors and are athletically inclined, it means a loss of all of these pleasures. For these, too, both rich and poor alike, anything that will give a restoration to the full capacities of life is highly desirable.

The time element in the healing of fractures of the neck of the femur is the most important. Excepting the children the time ranges from one year upwards. Usually one is so much absorbed in obtaining a bony union after fracture of the neck of the femur that the time element falls into obscurity and becomes a secondary and minor factor. Such a long time is, however, ill spared, or not sparable at all, by the daily worker and is rebelled against harshly and emphatically by his richer and more fortunate brother. Any method, therefore, that will shorten the period of disability is more than welcome for both poor and rich alike.

Up to the present time the results of the treatment of fracture of the neck of the femur—and I emphasize again that I refer to those described in group 2 of the opening paragraph of this communication—have been comparatively poor. In those insufficiently treated, or badly treated, it is

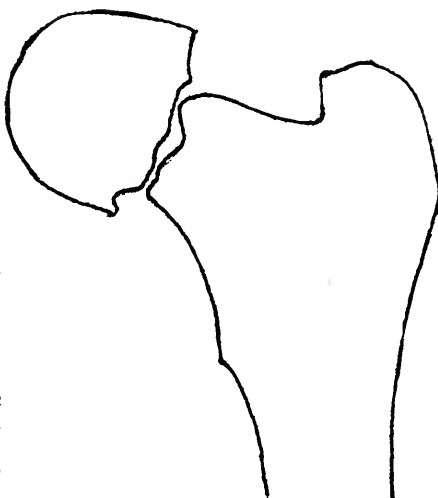


FIG. 2.

more than probable that solid bony union does not occur in more than ten or fifteen per cent. of the cases and these probably include all of the impacted fractures. While the cases expertly treated by a few specially gifted men throughout the country undoubtedly show better results, I feel very sure that if the results of the work of a large number of average workers—after all that is the kind of result that counts in the long run—were analyzed, the results would be little better than the indicated ten to fifteen per cent. even when the best forms of conservative treatment were employed. This is rather a bad showing.

We are confronted, therefore, with a type of fracture which suffers from the following notoriously bad features: from being markedly disabling; from destroying completely the individual's earning capacity; from consuming a long and oftentimes unwarranted time in healing; from frequently leading

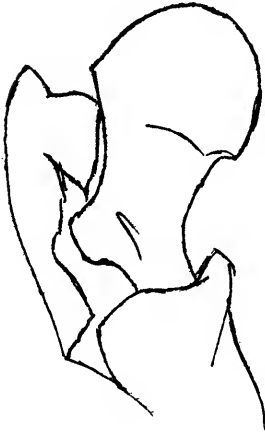


FIG. 3.

to distortions of anatomical structure of the femoral neck resulting in a diminution of function in the hip-joint and a crippling of the individual's activity even when bony union (mal-union?) is obtained; of commonly resulting in a failure to heal in which case permanent invalidism follows. Which method, conservative or other, in view of these discouraging features and factors, shall be considered best for men and women in adolescence or in the prime of life?

Shall it be the traction method? I have already referred to this method. Traction in the treatment of fracture of the neck of the femur had best be given up entirely. The method does not permit an accurate apposition and retention of the fragments and it yields the highest percentage of failures.

Shall it be the use of plaster and the abduction method? I quote from Whitman: "In spite of the development of the abduction method of treatment, we may assume that a certain proportion of transcervical fractures and fractures by decapitation (group 2 of our classification) will not unite. In determining this proportion we may range between the reports of Campbell, who obtained union in 85 per cent. of this type of fracture, and Delbet, who states that such fractures never unite under any form of treatment." Coming from this source the statement speaks volumes.

The average time necessary for the efficient healing of a fracture of the neck of the femur is, probably, considerably in excess of one year. A much longer period is no unusual time. For the average person this period is much too long to give up, especially if the method does not succeed in obtaining bony union. Shall one always be conservative, however, and give the plaster method a fair trial in every case before proceeding to any more radical measure? The probatory use of plaster and the abduction method under such circumstances would probably consume from three to four months with most surgeons and orthopedists and possibly much longer with a fair proportion of the remaining minority. If for any reason the method had to be abandoned,

## FRACTURE OF THE NECK OF THE FEMUR

because of the lack of the evidences of any attempts at union, the elapsed time would be a total loss both economically and from every other standpoint.

Another important point with the use of plaster is found in the changes that the upper fragment undergoes in those cases in which healing does not occur. The head commonly becomes atrophic and thin and becomes incapable of bearing sufficient weight. In a large number the neck becomes partly absorbed and in many the absorption is complete. Then, too, shortening in the muscles and soft parts becomes fixed, and it becomes impossible to overcome it at any late period so that the shortening persists permanently. The ligaments of the joint also, become abnormally stretched and strained in various directions.

In such late cases operation becomes imperative. When operation is undertaken at this late stage the consummation of the attempt does not result in a concomitant restoration of function at all proportionate to the degree of the bony union because of these changes.

An operation at this time, therefore, would be futile from this standpoint, whereas if it had been carried out successfully at those early times when the parts were in relatively normal anatomical condition, it would have yielded a femoral neck



FIG. 4.—Taken after operation.

of a normal contour and interior structure and it would have been followed by a proportionate return of function. A late operation causes a considerable loss of possibilities that would go with an early operation. Late operations, then, must be considered as makeshifts and one must not be surprised—rather, it ought to be expected—when incomplete results especially as regards function are obtained. I cannot illustrate this better than by the notes of the two following cases:

Hospital No. 147776. The patient fractured the neck of his femur two years before admission to the hospital by falling from a car. The man was forty-eight years old at the time of the injury but was otherwise a man of robust physique. He had been treated in the usual conservative manner at his local hospital in New Jersey by the application of a plaster hip spica which he wore for six months with no apparent benefit. At the time of my examination he complained of continued soreness in the hip while at rest and of much severe pain whenever he attempted to use the extremity, so that not only was he unable to continue his occupation as a bricklayer but he was also unable to walk any considerable distance beyond a few hundred yards before the pain compelled his stopping and resting. He wore no retentive apparatus. At this time the neck of the femur had been entirely

absorbed as demonstrated in the X-ray pictures and the head of the bone was considerably atrophied. Motion was free in all directions. There was a moderate shortening of the affected extremity. He walked with a marked limp and was unable to rise unaided from a squatting position on the floor. The case seemed ideal from every standpoint for the bone pegging operation. He was quite eager to submit to any operation that promised relief.

I operated upon him according to the technic to be subsequently described and pegged the neck of the femur with a living graft taken from its shaft. The patient made an extremely satisfactory convalescence and the fracture healed apparently with bony union and a moderate amount of exuberant callus.

Two months after operation he walked about without any brace. Abduction never reached its normal. The limb was held in a relatively adducted position

as compared with the median line of the body. The shortening persisted. Because of these disadvantageous factors the patient still walked with a limp. He was, however, able to squat down on the ground and rise therefrom unaided, something which he had previously been unable to do. For a number of months he was free from pain; then some pain appeared at the site of operation and persisted. (Figs. 4 and 5.)

Hospital No. 190,-494. This patient was fourteen years old at the time of his injury. In falling from a bal-



FIG. 5.—Final result, taken about five years after operation. Most of the bony union has taken place at the upper part of the plane of fracture immediately around the graft. Compare with Fig. 4.

cony he fractured the neck of his femur. Conservative measures were tried at first. The fracture was immobilized in abduction according to the Whitman method. The fracture seemed to be healing at first, according to the evidence shown by the röntgenograms, but, later, this opinion was shown to be incorrect; nevertheless we waited four months before operation was resorted to. It seemed inadvisable to wait any longer because the neck of the femur was beginning to show evidence of absorption and the head of the bone of atrophy. At this time motion was free in the hip-joint in all directions and was of normal extent; and there was an inconsequential shortening of less than one centimetre. The bone pegging operation was then done with the technic employed in the first case. (Figs. 6 and 7.)

This patient, too, made an uneventful recovery. The cast was allowed to remain for two months, after which an ambulatory splint was substituted and the patient was permitted to walk at first with crutches until he was accustomed to the brace, and then without them. The brace was worn for four months (six months since operation) and was thereafter discarded.

## FRACTURE OF THE NECK OF THE FEMUR

The final result is most excellent. Röntgenographically and clinically there is solid bony union between the parts. There is no coxa vara deformity. The graft has become thoroughly incorporated in the bony tissue of the femur so that it is indistinguishable; the region of the shaft from which the graft had been taken has filled up with normally appeared bony tissue. Indeed a comparison of both sides is necessary before the operated side can be distinguished and then careful scrutiny is essential.

The function results are equally good. The boy can walk and run and leap with the same facility that he could before the injury was sustained. There is full power in the limb. He has no pain even under violent exertion; The range of motion is normal in adduction and circumduction; it seems very slightly less than the normal side in flexion and abduction. The shortening is less than one centimetre.

These two cases give much food for thought. Shall immediate operative interference be regarded as the method of choice for the treatment of fracture of the neck of the femur in robust individuals? The cases demon-



FIG. 6.—Taken within a few days after the injury.

strate the possibilities when the fracture has been pegged with a living graft at a reasonably early stage after the reception of the injury, and they show how these large possibilities are lost to a considerable extent when the fracture remains unhealed for an extraordinary length of time and the operation is done as a late measure.

In the old case the neck of the femur had been entirely absorbed. A shortening followed in the perpendicular diameter between the trochanter and head and the angle between the former normal line of the neck and the line of the shaft became diminished (coxa vara deformity). These defects were not, and could not, be corrected by late operation and, therefore, necessarily persisted thereafter. Whatever diminution of function resulted therefrom persisted similarly after operation. Following the operation there was bony union and good weight-bearing function; because of the impossibility of obtaining full abduction as was necessary the limp persisted. The latter was aided by the shortening of the extremity which had become firmly established in the long period since injury. The weight-bearing power, while sufficient for ordinary use, was not quite sufficient when active use of the limb was attempted, and shortly some pain appeared after excessive use. An incomplete result was, therefore, obtained as far as regards function.

In the fresh fracture union was rapidly obtained. The resulting union was not accompanied by any anatomical distortion, nor by any shortening of the

neck. The normal angle of neck to shaft also remained undisturbed. The normal range of adduction and abduction was retained in normal and equal proportion and was associated with normal function. No atrophy being present, weight-bearing was sufficient both in periods of comparative rest and in periods of active motion. A complete result was obtained in all directions.

In either case the length of time of confinement to bed and house was limited to a comparatively few months. Thereafter in the fresh fracture, even though the patient wore a retentive apparatus to guard the graft and the freshly healed fracture from any undue strain for a few months longer, the patient was enabled to go about with absolute comfort.

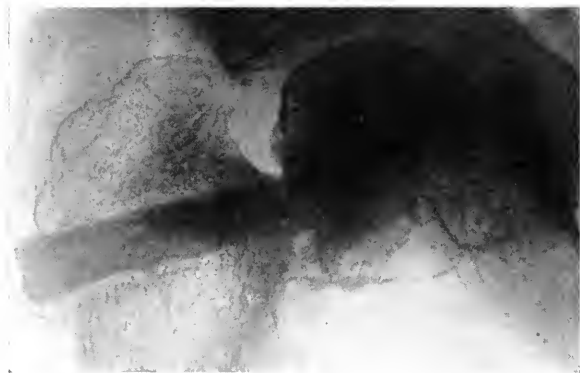


FIG. 7.—Taken about two and a half years after operation.

These experiences have led me to believe that this method of pegging the fracture with a living graft practised immediately after the injury is received is the method of choice for fracture of the neck of the femur in robust individuals. The great advantages of immediate operation include (1) an accurate apposition of the fragments, and (2) their permanent retention in that position until the fragments are united; (3) the use of a living graft to encourage and aid the formation of sufficient callus; (4) a marked diminution in the time necessary for complete healing of the fracture; (5) the consequent economic saving; (6) the better anatomical result including no loss of the neck angle, no shortening of the neck itself, no abnormal changes in the muscles, ligaments and soft parts generally; (7) the consequent better results obtained functionally.

There are no drawbacks to the use of the operative methods aside from the ordinary risks of operation, namely, hemorrhage, shock and infection. In the present state of our knowledge these dangers are entirely preventable and should not occur in any good hospital environment.

The use of a living graft is ideal for this purpose and is vastly superior to any metallic, beef bone or other artificial means of fixation and support. This opinion, in the present state of our knowledge, seems incontrovertible and is acceptable as correct in the best circles.

The following is essentially the technic which I have employed:

I recommend that operation be done within a few days after the injury is received. The patient is properly prepared and is put on an orthopaedic table (I prefer the Hawley table). The injured extremity is pulled down until there is slight overcorrection of any shortening; the limb is abducted widely. Any



sagging of the trochanter on the injured side is corrected by an assistant's hand or by a band supported from the overhanging upright. The opposite extremity is put in similar position. With the aid of palpation and the X-ray pictures the trochanter, the head and neck—in fact, the whole upper extremity—of the femur are outlined indelibly on the skin; with a little practise this can be very accurately done. Thereafter the skin is sterilized and the parts are appropriately draped with sterile sheets, etc. (Fig. 18).

A sufficiently long (6 to 8 inches) incision is made on the outer aspect of the hip and thigh extending from about two inches above the tip of the trochanter downwards; the fascia femoris is similarly divided; the muscles are separated bluntly and the upper segment of the femur and the trochanter major are exposed to adequate view by retraction of the soft parts. Bluntly with the finger the muscle planes are separated and raised from the underlying skeleton until the capsule is reached and, always, it is easy to reach the area of fracture and to palpate this through the capsule which need not be necessarily opened. I have not found it necessary to make any second incision in front directly over the joint. With the



FIG. 8.—Taken about two months after operation.

aid of the finger in the wound and with the outlines of the parts on the skin as guides, a hand drill is applied at the base of the trochanter and a hole is drilled up into the neck and head of the bone and lying in their centre as far as seems necessary from the X-ray pictures; the latter distance is accurately measured previously on the röntgenograms and is used as a guide in drilling. I use a hand drill—the Hudson drill—with the cerebellar attachment and appropriate burrs have served me very well. I prefer hand instruments to motor-driven ones, but there is no objection to the latter type if so desired by the individual operator.

As soon as one is sure that the drill hole is sufficiently long, the drill point is disconnected from the main part of the instrument and is allowed to remain *in situ* as a temporary support until the graft is ready for insertion.

The graft is taken from the outer aspect of the shaft of the femur lying in the wound and extending from a short distance below the base of the

trochanter downwards. Again I use hand instruments—chisel and mallet. The graft to be removed is accurately outlined beforehand. The graft includes periosteum and the entire thickness of the cortex, together with a generous layer of cancellous tissue and the endosteum; it reaches into the marrow cavity. The graft is so cut as to fit loosely in the drill hole, extending into the neck and head of the femur. I believe this has advantages: (1) it is easy to introduce; (2) it allows a certain amount of drainage around itself; (3) no pressure necrosis will occur and no sequestra ought to form; (4) it will be easier to the graft to find adequate nourishment; (5) a small amount of blood will collect in the drill hole around the graft and will encourage callus formation; (6) a large graft is permissible.

As soon as the graft is ready, the drill point is withdrawn and the graft is quickly inserted in its place; it should not project beyond the trochanter surface. The wound is then ready for closing. I have not found it necessary to do anything to the bed of the graft in the femur nor to secure the graft in its new bed by any suturing; the closure of the soft parts accomplishes this accurately. The muscles, fascia and skin are approximated individually with interrupted sutures of catgut. No drainage of any kind is necessary.

During all of this time the patient has been securely held on the table in the proper position for the application of the necessary immobilizing cast. All one does now is to drop the foot of the Hawley table and the patient is ready for the cast. It is not necessary to include the lower part of the leg or foot, but it is necessary to include the upper half of the leg, the knee, the entire thigh, the hip and the pelvis and abdomen as far as the lower thorax. This will give adequate immobilization of the hip.

It is possible to do the entire operation within thirty minutes. This is a relatively short operative time. The degree of shock is at a minimum and is easily withstood by any patient even if in only fair condition. The reaction is usually of a very minor character.

The cast is left undisturbed for two months. At the end of that time it is removed and an ambulatory splint is prepared. Meanwhile the parts are massaged and the joints all gently moved every day until a fair amount of power and range of motion returns. At the end of the third month the patient is gotten out of bed and permitted to walk with the aid of the ambulatory splint, at first with crutches also, but within a few days without them. Within a short time the patient accustoms himself to the apparatus and can get about very well indeed. At the end of six months it is safe to discard the brace entirely.

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## SPRAINS OF THE RHOMBOIDEUS MINOR MUSCLE

A STUDY OF ONE HUNDRED AND FIFTY INJURIES OF THE SHOULDER GIRDLE

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SURGEON TO THE CAMBRIA STEEL COMPANY

BECAUSE of its peculiar anatomical make-up, a freely movable ball-and-socket joint capable of performing a greater variety of movements than any other joint of the body, held in place not by strong ligamentary attachments, but deriving its security to the trunk mainly through its muscular coverings, the shoulder joint is probably more susceptible to traumatic lesions than any other joint of the body. At the same time text-books have practically nothing to say in regard to the physical position of muscles in relation to their mechanical effect when a joint is put out of gear by some lesion of the shoulder or its immediate neighborhood. The ligaments have comparatively little clinical importance. The muscular and fibrous planes, bursæ, and nerves are, therefore, exposed to manifold injuries either from overstretching or direct blows. There is no joint so likely to provide traps for the unwary surgeon, and a patient who cannot raise his arm high enough to fasten his collar or brush his hair remembers his surgeon daily and not with thankfulness if he feels his injury has suffered neglect.

How often have we diagnosed a "sprain of the shoulder" merely to satisfy a patient's anxiety concerning his injury, for he then puts at rest his fear and feels that it will soon get well with poulticing, rubbing, or the application of a patent liniment?

And how seldom is an attempt made to diagnose a sprain with some degree of localization of the structures involved, with the idea of applying appropriate treatment so as to rest or "splint" that particular overstretched muscle or ligament? The term "sprain" applied to the shoulder means no more than the term "peritonitis" applied to an abdomen, and the treatment

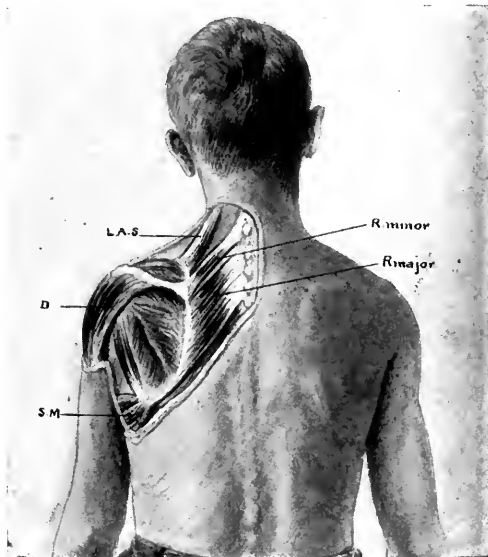


FIG. 1.—Dissection showing normal position of interscapular muscles—the skin, trapezius and latissimus dorsi having been removed. Note almost horizontal position of spine of scapula, also origin and insertion of rhomboides minor muscle where tenderness is found.

of a "sprain" of the shoulder as does "peritonitis" of the abdomen demands measures appropriate for that individual type of pathology.

The literature describes the classical acute lesion of the shoulder girdle sufficient to require emergency treatment, such as dislocation or fracture, but excepting description of subdeltoid bursitis we read very little of the patient who presents himself a day or two after the accident on account of pain or disability, or else seeks advice in a week or two because improvement under home remedies has been so slow that he fears the injury is more serious than he at first supposed. An analysis of one hundred and fifty successive cases of shoulder injuries observed at Cambria Steel Company hospital, excluding



FIG. 2.—Showing normal position of scapula and rhomboid muscles.

burns and very minor injuries, revealed twenty-six varieties of lesions in and about the shoulder. As would be expected, severe contusions with accompanying temporary palsy or periostitis of superficial bony prominences, such as the acromion process or spine of the scapula, make up thirty per cent. of the lesions. About twenty-five per cent. of the lesions are sprains of various individual muscles or muscle groups. Dislocations and fractures make up eighteen per cent., while only six per cent. are diagnosed subacromial bursitis.

Twenty-five per cent., therefore, of our lesions are sprains, and excluding severe contusions

it is very surprising to know that in our series one lesion which I have termed sprain of the rhomboideus minor muscle is more frequent than any other traumatic lesion of the shoulder.

Because of its frequency of occurrence and its remarkably constant symptomatology, a description of this particular sprain might not be amiss.

It occurs usually in those performing heavy or strenuous labor such as swinging a sledge, firing a furnace, or the sudden lifting of a heavy weight. At the time of the sprain he feels a sudden knife-like, sticking, or stabbing pain just median to the base of the spine of the scapula. Occasionally he tells us it felt as though he pulled a leader. Pain bothers him for fifteen to twenty minutes, but he usually resumes work and finishes out the day. That night he notices aching between the shoulder blades and disability begins the following day when pain and aching accompany use of his arm.

An examination reveals a very definitely localized point of tenderness

about the size of a quarter just internal to the base of the spine of the scapula. He can abduct his arm to about  $90^{\circ}$  (Fig. 3) at which point he suddenly feels aching pain referred to the point of tenderness. Further elevation of the arm aggravates the pain, which is worse when the arm is fully abducted and passed anteriorly over the chest so that the hand rests upon the opposite shoulder with the elbow at height of the brow. Aching between the shoulder blades at night is a common symptom. With the head rotated to the side of the injury, if we tilt it on its axis to the opposite side, he will complain of pain referred to his point of tenderness. Standing with the body erect and shoulders thrown back is the most comfortable position for him.

In order to explain the symptomatology it is well to review the muscular action in raising the arm. Abduction is mainly produced by the interaction of the deltoid, trapezius, and the serratus magnus. (See Fig. 1.) The serratus magnus arising from its nine or ten fleshy digitations from the upper eight or nine ribs and passing backward to be inserted along the vertebral border of the scapula, serves to keep the scapula closely applied to the thoracic wall and draws it laterally. Since the portion inserted into the inferior angle is

the strongest, a fulcrum action is produced and the scapula rotates, raising the lateral angle. By this action the serratus plays an important part in abduction of the arm, since, in the first place, by fixing the scapula it allows the deltoid to expend its action on the humerus, and, in the second place, after the deltoid has completed its action and has raised the arm through about  $90^{\circ}$ , further elevation through another  $90^{\circ}$  is accomplished by rotation of the scapula resulting from the combined fulcrum action of the serratus and the trapezius. It is by this muscular combination that the interscapular muscles—the rhomboideus minor and major and levator anguli scapulæ—are overstretched.

To offset the strong muscular force of the serratus, deltoid, and trapezius combined, we have a much weaker counter-action produced by the inter-



FIG. 3.—Arm at  $90^{\circ}$  from chest wall, normal position of scapula and rhomboideus shown by white dotted line. Black dotted line shows change in position with arm abducted to  $90^{\circ}$ , shaded area showing increase in length of rhomboideus. Pain is first experienced at this degree of abduction.

scapular muscles—the rhomboideus major and minor and levator anguli scapulæ—plus the force of gravity due to the weight of the arm.

It is not unusual then, that a sudden contraction of the trapezius, deltoid and serratus would overstretch this weaker interscapular group. The rhomboideus major having a wide origin from the spinous processes of the four upper thoracic vertebræ and intervening interspinous ligaments and a wide insertion into two-thirds of the vertebral border of the scapula and being stretched the least, suffers the least, while the band-like rhomboideus minor, arising from the spine of the sixth cervical vertebra and inserting into the vertebral border of the scapula at the base of the spine of the scapula, with

more obliquity to its fibres is overstretched more, with a resulting avulsion of fibres at its insertion into the spine of the scapula where the tenderness is found.

Examining into the causes of our injury, such as swinging a sledge, firing a furnace, lifting a heavy object, sudden pulling upon objects with arms extended, we find that pain occurs at the end of a pitch of a shovel or at the end of the swing of a sledge; in other words, at the position where the lateral angle of the scapula is raised and the rhomboideus minor is on the greatest tension.

Clinically pain is produced only on those movements which elevate the lateral angle of the scapula, change the angle of spine, and



FIG. 4.—Arm fully abducted, showing further increase in length of rhomboideus from 90° to full abduction indicated by solid black area. Cross shading indicates position of muscle in Figure 3 and plain shading the normal length of interscapular muscles.

depress the base of the spine of the scapula, producing tension on rhomboid muscles.

Occasionally we find slight pain and tenderness near the spinous process of the last cervical vertebra at the origin of the rhomboideus minor, and in thirty per cent. of the cases there was slight tenderness along the vertebral border of the scapula below the spine in the region of the rhomboideus major.

We would deduce, then, that any muscular movement producing elevation of the lateral angle of the scapula, especially when occurring suddenly, over-stretches the interscapular muscles and gives potential etiology for sprain of the rhomboideus minor.

The treatment is based on anatomic lines to cause relaxation of the overstretched muscle. The shoulders are thrown back so as to lessen the interscapular space and criss-cross adhesive straps are applied maintaining

this position. The arm is placed in a sling and a small pad placed under the adhesive over the point of tenderness to possibly hasten the absorption of the serous effusion at the point of rupture or strain.

The above treatment gives immediate relief from aching, and pain on abduction is greatly reduced. We have several times removed the cross strapping too early and patients have requested its reapplication to obtain relief.

Because of the frequency of occurrence of sprain of the rhomboideus minor, the unusual constant symptomatology and clinical picture, the efficacy of simple and proper treatment, together with the fact that it is of sufficient seriousness to cause industrial disability, justify a description and demand cautiousness for diagnosis of this lesion.

TRANSACTIONS  
OF THE  
PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held April 3, 1922*

The President, DR. JOHN H. JOPSON, in the Chair

TETANUS FOLLOWING HERNIOTOMY

DR. GEORGE P. MULLER reported the following case:

A man, aged thirty-seven, was operated on for a recurrent inguinal hernia. Chromic catgut used throughout. Rubber dam drainage in the fat for twenty-four hours. Patient had scratch marks on the abdomen from shaving during preparation and had cut himself on the face on the day before operation. No other etiological factors. Eight days after operation he complained of soreness in the region of the wound and two days later trismus was noted. Death occurred eleven days after operation. Patient treated by intravenous and spinal tetanus antitoxin. Wound contained no tetanus organisms.

PROLONGED WELL-BEING IN CASE OF INOPERABLE CARCINOMA OF  
SIGMOID COLON TREATED BY COLOSTOMY

DR. GEORGE P. MULLER presented a man, sixty-two years of age, who was admitted to the Misericordia Hospital, August 18, 1920, complaining of "cramps" when the bowels moved; some blood in stools, loss of 20 pounds in weight. At operation (August 21) a mass was found in the sigmoid flexure of rather large extent and almost completely occluding the bowel. Many small nodules were scattered under the pelvic peritoneum. Six or seven nodules the size of grapes were found in the liver. As the case was deemed inoperable from the radical standpoint, an inguinal colostomy only was performed.

The patient did well. A Wassermann test was pronounced negative. Three months later he had gained 5 pounds and nineteen months later he had gained 13 pounds since the operation. He sleeps well, eats well, has no pain, and the bowels move every day between 9 and 12 A.M., through the colostomy bag. They move suddenly as though propelled by a peristaltic movement. Practically no discharge comes from the anus.

*Comment.*—This case well illustrates the advantage to be obtained by conservative treatment of an advanced carcinoma of the lower colon, and the formation of a colostomy before acute obstruction occurs. Cripps in 1912 reported upon his results in colostomy as showing a mortality of 40 per cent. in twenty-four cases when the operation was done in the presence of obstruction, whereas of forty-four cases oper-





FIG. 1.—Lower tray.



FIG. 2.—Appliance mounted on skull, lateral view.

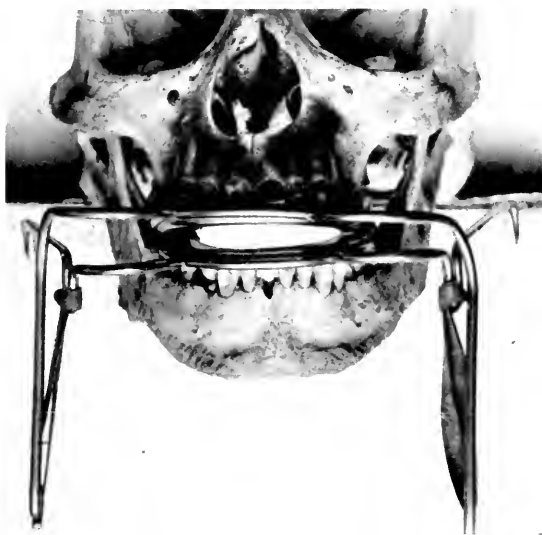


FIG. 3.—Appliance mounted on skull, anterior view.

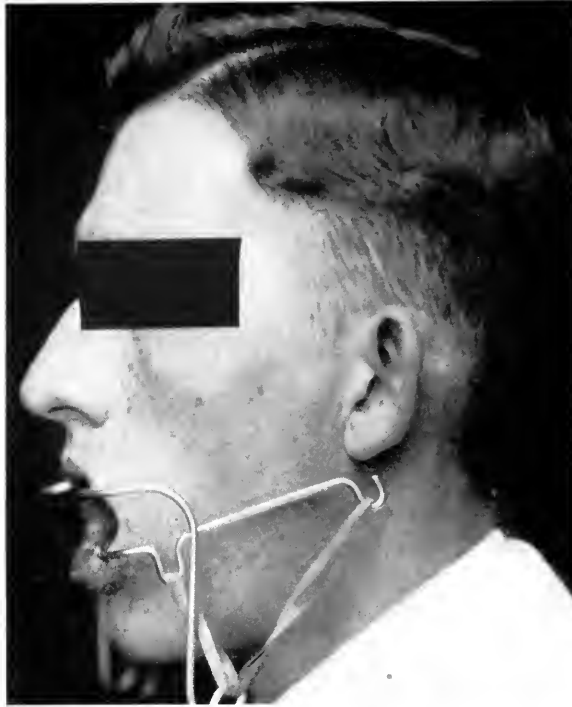


FIG. 4.—Appliance inserted in mouth, lateral view.

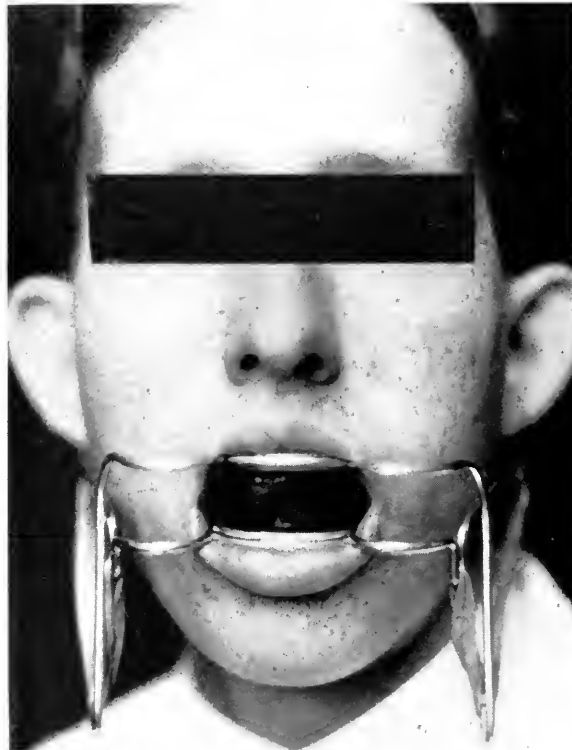


FIG. 5.—Appliance inserted in mouth, anterior view.

ated on before acute obstruction developed there were no deaths. Paul in the same year reported twenty-one cases with obstruction and approximately a 50 per cent. mortality, and 125 cases without obstruction with a mortality of only 4 per cent. In regard to longevity Paul noted that the cases having colostomy lived an average of twenty-two months, whereas those patients of inoperable cancer left alone only lived an average of seven and eight-tenths months.

#### UNIVERSAL JAW DILATOR AS AN ADJUNCT IN THE TREATMENT OF MANDIBULAR ANKYLOSIS

DR. ROBERT H. IVY said that to insure permanent success in the treatment of any form of chronic limitation of motion of the mandible, whatever operative procedure is performed it should be supplemented by mechanical stretching apart of the upper and lower teeth. In mild cases, such as frequently follow acute inflammatory conditions involving the muscles of mastication or fracture in the region of the angle, mechanical treatment alone may suffice to bring about free motion, without resort to operation. Many forms of apparatus, from the spring-clip clothes pin and the rubber cork inserted between the teeth to the most complicated devices, have been used for this purpose. It is recognized that a constantly acting mild force, either by springs or rubber elastic, will accomplish better results with less danger of injury than sudden positive application of screw pressure acting powerfully for brief periods at repeated intervals. Heretofore, it has generally been necessary to first obtain impressions of the teeth prior to the construction of an apparatus suitable for the individual case. This frequently occasions a delay of several days before insertion of the appliance, during which recontracture of the jaws occurs. In the jaw dilator here presented, it is believed that these objections have been overcome, as it can be made as a stock appliance, in three sizes, ready for immediate use either after operation or in other cases where there is an initial opening between the teeth of one centimetre. It can be easily fitted by the surgeon, and is practically as stable as an apparatus that has been made from dental impressions of the individual. The construction is extremely simple, the two parts being flat metal trays passing between the occlusal surfaces of the upper and lower teeth. The trays can be inserted through a space of less than one centimetre between the upper and lower incisor teeth, which is manifestly insufficient space to obtain impressions. To the outer sides of each tray are soldered heavy wires which pass out of the mouth and curve backward over the cheeks in the manner of Kingsley splints. The wire attached to the upper tray on each side turns down at a right angle about opposite the premolar region and ends in a hook about three inches lower down. The wire attached to the lower tray passes directly backward horizontally and is provided with a hook at a point opposite the downward turn of the upper wire. The dilating force is a heavy elastic band placed between these hooks on each side. This application of dilating force in the manner described is original with Darcissac of Paris (*Dental Cosmos*, March, 1922), who has proved its value in numerous cases. Darcissac, however,

made individual apparatus from impressions of each case, casting metal caps to fit the teeth. The advantage claimed for the present appliance is that it is ready for immediate use in any case with not less than one centimetre of separation, without the necessity of impression taking. It can be applied readily without any special skill, and can be used much earlier in the case when there may be insufficient room for taking impressions of the teeth. The elastics produce a constant counteraction to the powerful elevator muscles of the mandible, which at the same time are permitted to function, the upper and lower jaws being at no time fixed. Lateral movements as well as opening and closing are possible. Where additional stability is desirable the trays may be filled with a little softened dental impression compound before insertion, to receive the imprint of the teeth. This compound can be renewed from time to time. The dilating force can be readily regulated by the size and tension of the elastic bands. In some cases, where it is advisable to aid in the forward movement of the condyle as the mouth opens, this can be accomplished by running a second rubber band between the hook on the wire attached to the upper tray and one placed at the extreme posterior end of the lower wire.

He was indebted to Mr. J. A. Eberly, Jr., of the Senior Class of the University of Pennsylvania School of Dentistry, for following his suggestions in the construction of the original models of this appliance; also to Messrs. George P. Pilling and Son Company, Philadelphia, for making the finished appliance.

*Stated Meeting Held May 8, 1922*

The President, DR. JOHN H. JOPSON, in the Chair

#### BRANCHIAL FISTULA

DR. BENJAMIN LIPSHUTZ presented a girl, six years of age, in whom, after an attack of scarlet fever two years ago, there appeared a small opening surrounded by an inflammatory areola and discharging pus, situated at the anterior border of the right sternomastoid muscle between the angle of the mandible and the inner end of the clavicle. Pressure over the latter caused the exit of distinct pus. On examination a distinct cord was felt which seemed loosely attached to the surrounding and subjacent structures and over which the skin moved freely. Colored fluid injected through it came out of the mouth. No probing of the tract was attempted because of the infection present, and because it is frequently impossible beforehand to know the type of fistula under consideration.

Operation at the Mt. Sinai Hospital, March 4, 1922, ether anæsthesia. An incision was made so as to leave a small disc of skin about the margin of the opening and extended upward and backward nearly to the angle of the jaw. On cutting through the skin, fascia, and platysma the sinus was exposed to view. It lay on the deep fascia

## EXOPHTHALMIC GOITRE

parallel to the sternohyoid muscle and was unexpectedly clear. It was rather easily separated from the surrounding structures, except its posterior surface, which was adherent to the carotid sheath, especially the internal jugular vein. Continuing the dissection, the entire fistulous tract was dissected upward to the digastric muscle, and separated without injury from its attachment to the pharyngeal muscle. The presence of the infection did not permit the inversion of the fistula into the mouth, as first advised by V. Hacker in 1897. The latter procedure can only be successfully carried out when the fistula is freely movable and has a lax attachment to the surrounding structures. Hacker, Whitacre, Helferich, and Dowd have reported cases in which the latter procedure was successfully performed. At times the excessive amount of fibrous tissue, muscle, etc., in the wall of the tract prohibits the inversion of the fistulous tract. In some of the fistulæ it is impossible to dissect them away without destroying important next structures, a procedure which the primary condition does not justify. A mouth-gag was then placed in the mouth and the blunt end of a probe was passed upward from the upper end of the operative wound in the neck to the floor of the mouth, to the anterior inferior border of the right tonsil. A small incision was made in the oral mucous membrane over the probe. The distal end of the fistula was tied to the open end of the probe with silk and the probe drawn into the mouth, the fistulous tract following until it seemed to be on a stretch. The distal portion of the fistulous tract was removed and the portion remaining was fixed to the mucous membrane of the mouth by two chromic catgut sutures, as advised by König. The fistula now has both openings in mucous membrane, the inner end in Rosenmüller's fossa, the other in front of the tonsil instead of in the skin. There is thus produced an open canal beneath the oral mucous membrane in which retention cannot take place.

## EXOPHTHALMIC GOITRE

DR. CHARLES F. NASSAU presented a woman, forty-nine years of age, who first noticed thyroid pressure symptoms about fifteen years ago. From that time the swelling gradually increased in size. Three years ago she began to suffer from dyspnoea and symptoms became progressively worse. For the past two years she has had the oncoming of the symptoms of hyperthyroidism, everything except exophthalmos. One year ago she was in bed three months with dilatation of the heart. For the past year she has been having X-ray treatment, having in the past refused operation. Admitted to the Mt. Sinai Hospital in a terrible condition; seemed asphyxiated and about to die. On April 11, 1922, Doctor Lipshutz made a straight incision in the median line and divided the isthmus. Since then it was determined that she also had substernal goitre, probably bilateral. Heart feeble and pulse too rapid to count. On May 8 her heart-sounds were fairly good, pulse 90 to 100. Patient not able to lie down, had to be operated on partly sitting up. Operation under local anæsthesia morphine. Goitre ex-

## PHILADELPHIA ACADEMY OF SURGERY

tremely difficult to get owing to the fibrous development from X-ray. Patient was now entirely relieved of all cough, not nervous, pulse-rate down and quite comfortable.

DOCTOR NASSAU presented also a man, thirty-three years of age, who one year ago noticed enlargement of the neck. He had palpitation of the heart and shortness of breath. On admission had exophthalmos, etc. Pulse 80 to 140, had difficulty in keeping patient in bed; almost continual vomiting. He was kept two weeks in bed before operation with ice-bags and oxygen inhalations. Ligation of one side was done in his room. The reaction was very great for seven days, when the second ligation was done. Patient was discharged to come back. On his return, under local anæsthesia, the greater part of the right lobe on the right side was removed, and there was practically no reaction. In two weeks the left side was operated on under local anæsthesia, and they removed practically all of the left side except the stump around the vessels. The neck is now fairly symmetrical, although there is still a lot of room for improvement. Pulse was 120 after second operation, temperature 101.

DOCTOR NASSAU then presented a third case, who had been referred to him at Frankford Hospital. The patient was excessively nervous, weighing 121 pounds on admission; weighs 151 pounds now. Purely toxic case with marked exophthalmos; no adenomata. Ligation without any ether. First one side and then the other. Then after a couple of weeks, he went in and took out both sides. One of the most perfect results the reporter has ever secured was in this case. The thyroidectomy was done at one sitting, because his reaction was so perfect. Pulse up to 180 after thyroidectomy.

A fourth case was then presented in the person of a man who noticed an enlargement in the neck one year ago, with all symptoms of exophthalmic goitre, thought to be purely toxic on account of the age. Ligation was done and patient allowed to go home for ten or eleven weeks. He came back, and a bilateral partial thyroidectomy was done under gas anæsthesia. All difficulties cleared up.

In response to a question, Doctor Nassau said he always ligated the superior thyroid artery.

## FAT TRANSPLANT FOR PAINFUL STUMP

DR. HUBLEY R. OWEN exhibited a man whose leg had been amputated in January, 1920, at the junction of the upper and middle third of the leg. He complained of pain along the crest of the tibia, caused by pressure of his artificial leg. He also had a painful scar adherent to the internal condyle of the femur, and to the lower portion of the shaft of the femur. In December, 1921, two fat transplants were taken from the right thigh. One was placed under the painful scar of the left thigh, which was freed from its attachment to the femur, and the second transplant was placed over the crest of the left tibia. The scar of the amputation was opened, and the fat transplant was tucked underneath the skin of the stump so that the transplant made a good pad over

## GUNSHOT WOUNDS OF THE FEMORAL ARTERY

the crest of the tibia. The day before the patient presented himself before the Academy of Surgery he had played eighteen holes of golf and had worn his artificial leg without pain.

Doctor Owen stated that he had several amputations which complained of pain over the crest of the tibia in spite of the fact that the stumps were apparently good and healthy, and thought that placing transplant of fat so as to pad the crest of the tibia would relieve pain in such cases.

## CARCINOMA OF THE TONGUE WITH METASTASIS IN THE CERVICAL GLANDS UNDER TREATMENT WITH RADIUM AND X-RAY

DR. W. ESTELL LEE showed a patient, a man, who had been decidedly improved by the application of radium for carcinoma of the tongue. Up to the present time, four months since beginning treatment, the patient has had three applications of 100 mm. of radium, the needles being so applied as to surround the lesion and extended almost down to the epiglottis. In addition to this radium he has also had X-ray. Patient improved; pain much less, while before the use of the radium, pain was so great as to make life almost unbearable.

## MULTIPLE GUNSHOT WOUND OF THE ILEUM

DOCTOR LEE presented a boy, fifteen years of age, who was admitted with history of gunshot wound from small toy pistol. Absolutely without symptoms; normal pulse, temperature, and no pain. Two cm. to the left and one cm. below the umbilicus there was a small gunshot wound. Three hours after accident an exploratory laparotomy was performed. There was only a small amount of free blood in the abdominal cavity. Eight perforations were found within one foot of ileum. Two were near the mesentery and the other six were in such a small area that it would have been impossible to close them, so a resection was performed and an end-to-end anastomosis done. The abdominal cavity closed without drainage. Patient was practically recovered in three or four days. Doctor Lee stated that he felt that resection was justified in this case because the holes were so close together that the lumen would have been practically occluded if they had been sutured. Resection was done because of the danger of producing intestinal obstruction. He believes that all the wounds could have been closed except those involving the mesentery.

## GUNSHOT WOUNDS OF THE FEMORAL ARTERY

DR. GEORGE P. MULLER reported the following cases to bring out a discussion of certain points concerning blood-vessel ligation:

CASE I.—W. S., age eleven. He was admitted to the University Hospital June 7, 1918, suffering from a bullet wound in the right groin over the line of the femoral artery and one and a half inches below Poupart's ligament. The bullet had passed directly through the leg. Examination showed the leg slightly swollen, and wounds of entrance

and exit. A distinct hum was heard over the femoral artery at the site of injury and the pulse was felt behind the internal malleolus.

The injury was treated expectantly, but in five or six days' time some purulent material was discharging from the wound. Two weeks after admission it was noted that a pulsating swelling (not expansile) was developing in Scarpa's triangle. A few days later (June 24, 1918) operation was undertaken with the diagnosis of infected hæmatoma. Pressure was made over the common femoral in the groin and an oblique incision made. When the hæmatoma was opened it was found that much of it was fluid blood and that only a scab prevented furious bleeding. The artery was found to be cut half-way through. Attempts were made to reconstruct the vessel, but this was not successful. Accordingly it was doubly ligated. The vein showed a small nick, which, however, might have been made by one of the retractors. It was ligated. In so far as he could determine the profunda femoris was present. A rubber drain was introduced through the posterior wound and the anterior wound packed with gauze saturated with dichloramine-T. In spite of this chemical the wound became freely infected, and at one time he could see the stump of the femoral artery, nearly an inch in length, beating sharply, and hemorrhage only prevented by the catgut ligature. It was thought inadvisable to use Dakin solution, and accordingly boric acid solution irrigations were practiced successfully. The boy was discharged August 8, 1918, with the wound practically healed.

CASE II.—M. F., age seven. He was admitted to the St. Agnes Hospital February 6, 1922, with a history of having been shot through the groin a short time previously. He bled profusely and was in a state of shock on admission. He was given salt solution and later 500 c.c. of blood. There was no swelling, only the wounds of entrance and exit, and no signs of bleeding from the wound. Accordingly it was decided not to practice any operative intervention. The injured leg was colder than the right leg and slightly bluish, and of course gangrene was feared. Flannel bandages and hot-water bottles were applied. The child did well reacting perfectly from the shock, and in twenty-four hours showed evidence of collateral circulation having been established. The temperature declined and was normal on the fourth day, but thereafter showed an evening rise to about 101 degrees. On February 17, eleven days after admission, he was found by the nurse in a pool of blood. A tight bandage was applied and the hemorrhage stopped, but recurred five hours later. Patient pale and thirsty. His assistant, Doctor Ryan, opened up the wound and found a hole in the femoral artery at the point where the profunda femoris is given off. The common femoral was ligated, the incision swabbed out with iodine and rubber dam drainage inserted. The patient was very ill for a few days, but on February 28 the wound was clean and granulation tissue filling it up.

Subsequently the child developed an abscess of the leg, which was incised and drained. He was discharged on May 6.



The two points of interest that he wanted to bring out are: (1) The occurrence of secondary hemorrhage in each case, and (2) the viability of the limb after ligation of the femoral artery.

In regard to the first point, he had not made an exhaustive study, but he finds a general agreement on the dictum: "In case of primary hemorrhage, do not ligate the vessel unless it is bleeding at the time." Both of their Fellows who had written text-books of Surgery accept this rule. Makins, from the experience of the War, says: "When evidence exists that a large vessel has been wounded in the course of a track traversing the body or limbs, unless the conditions are favorable, it is not advisable to interfere primarily if no signs of progressing hemorrhage are forthcoming, nor indications that the vitality of a distal portion of the limb is becoming endangered."

As he looked back over the cases of gunshot wounds of the extremities which he had encountered, he felt that a certain degree of infection had occurred in nearly all. Different from military practice, they were admitted usually a few minutes after infliction. Different also, in that there is not the severe trauma of the tissues from the shattering blow of the shell fragment or high velocity rifle bullet.

Broadly applying the principles taught by the War surgeons, and as these wounds can nearly all be treated during the stage of contamination, not infection, he felt that in the future he would, *knowing the vessel had been cut*, promptly cut down and either suture the hole, repair the artery or ligate it, even though hemorrhage has ceased. Blood transfusion and modern methods enable surgeons mostly to disregard the shock complication.

II. Regarding ligation of the femoral artery: In 1891 Treves wrote that great risks attend ligation of the common femoral, from gangrene or secondary hemorrhage. Before the War gangrene was said to occur in 20 per cent. of femoral ligations, and in 50 per cent. where both artery and vein were ligated. Sencert (1918) is "of the opinion that ligation of the femoral artery is not as dangerous to the vitality of the limb as is commonly believed." He ligated the femoral eleven times (in three the common femoral) with no case of gangrene, where there was no large hæmatoma, but gangrene occurred several times in nine cases of the latter class. Makins observed gangrene in five out of thirty-five cases, and in two of these gangrene was present before operation. On the other hand, Heidrick, very recently (1921), gives detailed statistics covering cases of the last ten years. Ligation of the femoral was followed by gangrene in 20.7 per cent. He found gangrene more frequent following ligation below the branching off of the profunda than above. This is in agreement with the teaching of Treves. Ligation of the external iliac was followed by gangrene in 13.4 per cent. This again is in agreement with the older teaching of Treves and leads us to wonder whether it would not be better to expose the larger vessel through a fresh or clean incision, temporarily ligate it, and then tie

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both it and the femoral if the latter could not be repaired by suture. We had followed this principle with success for a number of years in the treatment of infected thigh stumps where hemorrhage was feared, ligating the femoral artery in Scarpa's triangle.

### SUBMAXILLARY SALIVARY CALCULUS

DR. B. FRANKLIN BUZBY read a paper with the above title.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting Held April 26, 1922*

The Vice President, DR. EUGENE H. POOL, in the Chair

### OSTEOMYELITIS OF HEAD OF THE TIBIA TREATED BY AN ATTACHED SKIN MUSCLE FLAP

DR. H. H. M. LYLE presented a man who was admitted to St. Luke's Hospital, November 2, 1920, with the following history:

While leading his squad against a machine-gun nest in Argonne, October 1, 1918, he was wounded by a bullet which passed through the femur, knee-joint, and came out through the head of the tibia. Five hours later he received his first dressing, being evacuated through Chalade, Villiers Dourcourt, reaching the latter evacuation hospital twelve hours later. First operation, incision with drainage, was done five days later. In the succeeding seven months he had seven operations. His leg was immobilized in a Thomas splint and the wound treated by the Carrel method. He went the usual round of the military hospitals and was finally discharged with the diagnosis of compound comminuted fracture of the femur and tibia with bony ankylosis of the knee—no sequestrum apparent.

On entrance to St. Luke's Hospital he had a discharging sinus situated on the inner side of the right tibia. The probe passed upward and inward for two and one-half inches. X-ray examination revealed a bony ankylosis of knee and an opaque injection was found to travel through the central portion of the ankylosed area between the tibia and femur.

November 8, 1920, the sinus was excised and the bony cavity thoroughly curetted and the Carrel treatment begun. The cavity was sterilized for twenty-four days.

December 3, 1920: A fat graft, taken from the abdominal wall, was inserted into the bony cavity and the skin closed over it. This failed and the graft was gradually extruded in the form of oil.

On November 12, 1921, the cavity was again curetted and sterilized by the Carrel method. Seventeen days later the cavity having been rendered sterile an attached skin muscle flap was inserted into the cavity and the skin button sutured to the mouth of the cavity. The graft took kindly and wound healed rapidly and has remained healed.

The following technic was employed: An incision five inches long was made parallel to the internal border of the tibia; the incision started on a level one inch above the sinus and two and one-half inches posterior. At the lower portion of this incision a button of skin the size of the opening of the sinus was left attached to the muscle, with a flap of muscle tissue sufficient in bulk to fill the cavity was dissected up,

the pedicle being above and posterior to the opening of the cavity. The skin between the cavity and internal border of the tibia was undermined and the muscle flap with the attached skin button was pushed under it into the cavity. The skin button was then sutured to the edges of the sinus and the wound closed without drainage.

His personal experience with fat graft has not been very happy; the last successful one that he had has broken down nearly two and one-half years after. The success in filling base centres with viable attached muscle has been so satisfactory that he had discarded the fat graft.

#### WHEELER PLASTIC OPERATION ON EYELID

DR. H. H. M. LYLE again presented a patient whom he had shown before the Society six weeks ago, in the preliminary stage of the Wheeler plastic operation of the eyelid. As completed it is impossible to see where the graft has been taken from the upper eyelid and the insertion into the lower lid is scarcely visible. The result shown speaks for itself and needs no further comment.

#### SOLITARY CYST OF THE KIDNEY

DR. JOHN DOUGLAS said that in addition to polycystic kidney, which is probably of embryonal origin, cysts of the kidney are classified as degenerative, perinephric, retention, simple or solitary, hydatid and dermoid. Solitary cysts are of comparatively rare occurrence. They are most common in women of middle age and most frequently involve the lower pole of the kidney. Usually they are single and increase slowly in size and are symptomless until the patient notices the presence of the tumor in the upper or lower abdominal quadrant.

Urine examination is usually negative unless secondary infection of the pelvis occurs, but a differential functional test may show diminished renal function due to pressure on the kidney by a large cyst. In the same manner pressure may cause a distorted pyelogram. A radiographic shadow of the cyst may be shown and cases are reported where calcification of the cyst wall may resemble a large calculus.

As a case of kidney cyst he presented a woman, sixty-five years old, who had suffered pain in the left inguinal region for ten days before admission to St. Luke's Hospital. Her bowels moved regularly but only with severe straining. She also had increased frequency of micturition at times. She had never vomited, and while the patient said she had no fever, her daughter said that during the past year her mother had occasional chilly feelings and had felt that something was wrong in the left side of the abdomen.

On admission a cystic mass about 16 to 18 centimetres in diameter could be felt extending out of the left side of the pelvis to the level of the umbilicus. On bimanual examination it appeared to move with the uterus, and a diagnosis of ovarian cyst was made. The urine was normal except for a very faint trace of albumen and a few epithelial and many white blood-cells. Blood-pressure was 170-110. Urea nitrogen

13 mgms. and blood sugar 110 mgms. per 100 c.c. of blood. The Wassermann was negative. Radiographic examination was made as the diagnosis of ovarian cyst did not seem quite correct, but the radiogram seemed to confirm the diagnosis, as the cyst shadow could be seen rounded above and appearing to rise out of the pelvis, lying to the inner side of the sigmoid and descending colon. It was not thought to be attached to the kidney.

At operation a very thin-walled cyst was found in the left lower abdomen which was free below and was attached above to the lower pole of the left kidney. An attempt to free it from the kidney caused so much bleeding that the cyst wall was cut away from its kidney attachment, leaving a surface 3 by 2 centimetres in diameter of cyst wall, attached to the lower pole of the kidney. This surface was well cauterized by carbolic acid followed by alcohol, a rubber dam drain inserted, and the wound closed. There was little drainage and the dam was removed in five days, the wound healing by primary union. The patient left the hospital healed on the seventeenth day and has had no further symptoms.

The pathological examination of the specimen removed is as follows:

*Macroscopical Examination:* Specimen consists of a portion of a cyst of the kidney. It is a thin-walled sac measuring 22 x 7 c.c. and from 1 to 2 mm. thick. It shows a few coarse lobulations, but for the most part is only a thin fibrous structure with no kidney tissue recognizable.

*Microscopical Examination:* Sections of the wall of the cyst show a densely fibrous membrane in which a few small kidney tubules are found infrequently, and only in the thicker portions. There is no epithelial lining covering most of the surface. The blood-vessels are frequently thrombosed and hyaline areas, probably fibrosed glomeruli, are frequently found.

The origin of these solitary cysts is of interest and is still a matter of dispute. Wood writes: "In chronic diffuse nephritis of the atrophic form group of tubes may be dilated. Apparently one or more of the larger tubes in the pyramids are obstructed and this causes dilatation of a corresponding group of tubes. Such a dilatation may be moderate in size or it may form cysts visible to the naked eye." While this is an adequate explanation for the smaller cysts, often multiple, which are frequently found at autopsy, below the capsule in atrophic kidneys, it hardly explains the large solitary cysts appearing in an otherwise normal appearing kidney.

Ziegler states that these single cysts are due to retention of secretion from a glomerulus from which its tubules have been cut off and do not function, although the rest of the kidney may be normal. Aschoff quotes Ruckert that all cysts of the kidney are due to congenital tissue malformation. Most of the other writers on the subject also quote this opinion of Ruckert as does Berner, but the latter differs from him in his conclusion that all the solitary cysts of the kidney are congenital.

In the case here reported, the appearance of the kidney with the exception of the cyst was normal. There were present a few small kidney tubules and hyaline areas, probably fibrosed glomeruli, in the thicker

portions of the cyst wall. This would suggest as the most probable cause for the cyst formation, the cutting off of some of the lower kidney pole containing glomeruli and tubules from the larger tubules due to a congenital malformation or developmental defect rather than by the growth and contraction of connective tissue, due to an inflammatory process, such as occurs and produces the multiple small cysts in an atrophic kidney.

DR. EDWIN BEER said that in a very extensive study of cysts of the kidney (note published in Professor Chiari's "Festschrift," 1908) he had arrived at the conclusion from serial section of several hundred cysts that cysts of three distinct types occurred in the kidney. The smallest cysts, never much larger than the head of a pin, were almost always derived from malpighian corpuscles and frequently at some part of the cyst wall glomerular tufts could be seen more or less atrophied. The contents of these cysts was usually colloidal material with more or less lime salts. The cysts which were next in size, growing as big as small peas, were usually of tubular origin, and in the walls of these cysts tubular epithelium could be readily recognized; the contents of these cysts was usually colloidal material, occasionally associated with lime salts. The third and largest cysts that he had encountered and studied, and to this group he believed Doctor Douglas' case belonged, were probably lymphatic in origin. A study of the walls of these cysts showed an endothelial lining with here and there in the walls accumulations of smooth muscle fibres. The largest cyst of this type that he had studied was about the size of a hen's egg. He had never sectioned cysts as large as appeared in the patient presented to-night. In the diagnosis of these cysts the pyelogram may be of great assistance, as it will show that the pelvis is distinct from the cyst, though the calyces and pelvis may show considerable distortion from pressure of the cyst against the kidney tissue. In the case presented to-night, one could readily understand how the diagnosis of ovarian cyst would be entertained and no extensive kidney studies made.

#### INCISIONAL HERNIA (FASCIAL FLAP OPERATION)

DR. CHARLES L. GIBSON presented a man, aged thirty-three, who was admitted to the New York Hospital, March 13, 1922. On January 1, 1916, he had been subjected to laparotomy for gunshot wound of intestine with removal of bullet from fifth lumbar vertebra. Wound broke open and healed by second intention.

Post-operative hernia became evident three months after operation. Has been increasing steadily, although he has been wearing a belt.

When admitted, protruding through the laparotomy scar was a mass the size of a child's head. It is reducible. Edges of opening can be felt. Gap estimated to be about five inches.

Operation March 15, 1922. Excision of scar tissue and refreshing of wound edges into separate layers which are united to each other. Extreme resulting tension is relieved by lateral incision anterior sheath

## ŒSOPHAGEAL DIVERTICULUM (TWO CASES)

of rectus in upper three-fourths of incision. Flap about two inches wide. All sutures chromic gut.

The wound healed by primary union. Discharged March 29th.

## ŒSOPHAGEAL DIVERTICULUM (TWO CASES)

DR. CHARLES H. PECK presented a woman whom he first saw on October 25, 1920, in consultation with Dr. W. W. Herrick. An œsophageal diverticulum had been discovered by Dr. Cornelius G. Coakley a few days before and the diagnosis had been confirmed by Doctor Herrick by X-ray plates and fluoroscopy. She had had trouble in swallowing with pain at times for two years, but a diverticulum was not suspected until Doctor Coakley's examination. In consultation with Doctor Herrick and Dr. H. H. M. Lyle the diverticulum was studied under the fluoroscope two days later. The position was posterior, it was pear-shaped, its convex apex reaching nearly to the level of the sternal notch. It appeared to have a fairly wide neck and its size was that of a small English walnut. Operation was advised, but the patient wished to defer it if possible, and was told that a delay of a few months would probably make little difference, as the obstruction and nutritional loss was moderate.

She was kept under observation by Doctors Herrick and Coakley until February 3, 1922, a period of fifteen months, when X-ray plates taken by Doctor Imboden showed an increase in size of at least 50 per cent. She had developed an irritating cough, which was thought to be due in part at least to pressure. Prompt operation was then advised, and on February 15, 1922, it was performed at the Roosevelt Hospital under gas-ether anæsthesia.

An incision was made along the anterior border of the left sternomastoid muscle. The omo-hyoid muscle and the great vessels were retracted outward; the thyroid gland, infra-hyoid muscles and trachea inward, exposing the œsophagus and the diverticulum freely. It was pear-shaped, about two and a half inches in length, rather broad at its base, shading off into the pharyngeal wall above. Inferiorly the angle with the œsophagus was acute. It was isolated by blunt dissection and drawn into the wound. A stomach tube was then passed into the œsophagus as a guide, and as the base was too broad for ligation. The pedicle was double-clamped about one-third inch from the œsophageal wall and the diverticulum cut away. A whip-over suture of 00 chromic catgut was placed loosely over the clamp, across the pedicle, and drawn tight as the clamp was removed. There was no leakage. A return row of stitches was taken, making the first closure secure. This line of suture was then carefully inverted by another row of the same material, taken Lembert fashion, and a third row, reinforced by a few interrupted sutures completed a satisfactory closure. The stomach tube was left in place up to the placing of the last tier of sutures to guard against narrowing of the œsophageal lumen, and was reinserted after completion of the suture to show that a good lumen was maintained. Before excising the diverticulum a coffer-dam pack of gauze had been placed at the lower angle of the wound to the inner side of the great

vessels, against the trachea and œsophagus, to wall off the mediastinum and protect it against future leakage. This was left in place and a second pack was placed above for further protection at the end of the operation. Temporary packs used during the operation were removed before placing the second permanent pack. A small additional rubber tissue drain was also placed just below the suture line, but not in contact with it. The upper part of the wound was closed with catgut and silk to the exit of the drains.

The permanent packs to protect the mediastinum are a necessary precaution as the œsophageal tissue heals poorly and some leakage before healing is complete almost invariably occurs. The time of operation was one hour and twenty-five minutes; the patient's condition remained good and there was very little post-operative temperature and pulse reaction.

Fluids were given by rectum with absolutely nothing by mouth for four days; broth and albumen water were commenced on the sixth day. The patient could not speak above a whisper for five days, but the voice began to return on the fifth day. On the seventh day, 40 ounces of fluids were taken by mouth. During the night of the seventh day leakage from the wound occurred for the first time, and thereafter there was some leakage with each ingestion of fluid, but at no time did it amount to any considerable proportion of the fluids swallowed. By March 3rd, sixteen days post-operative, the leakage had practically stopped, though a very little occurred from time to time. The permanent packs were removed by stages, commencing about the tenth day and were all out by the twelfth day. She left the hospital on the twenty-second day after operation (March 9th), and after March 14th (twenty-seven days post-operative) had no food leakage whatever. Soft solids were commenced on the ninth day and ordinary light diet on the twelfth day. The wound healing has progressed steadily and without incident and is now nearly complete.

The patient has now practically no discomfort in swallowing and eats ordinary food without difficulty.

DR. CHARLES H. PECK presented a second case of œsophageal diverticulum, a woman thirty-nine years of age, who was referred to him by Dr. Charles H. Mayo and Dr. G. J. Jackowitz, and was first examined by him August 24, 1921. A diagnosis of œsophageal diverticulum had been made and X-ray plates showed a good-sized pouch, placed posteriorly, its apex reaching nearly to the level of the sternal notch. No mass could be felt by palpation. Swallowing of solid food had become increasingly difficult and some regurgitation occurred at each meal, though she had as yet little apparent loss of nutrition. Operation was advised and performed on October 8, 1921, in one stage.

The technic followed was identical with that described in the previous case. A stomach tube was used as a guide to ensure a sufficient lumen after suture. The pedicle was divided with a cautery between clamps and a careful whip-over suture with fine chromic gut taken in three tiers. Cofferdam packs were placed below in the wound, the two lower ones to remain for ten or twelve days, and a temporary drain just



below, but not in contact with the suture line. Fluids by mouth were withheld for four days, and a 5 per cent. glucose solution was given regularly per rectum.

For twelve days there was no leakage of ingested fluids or food, but on the thirteenth day a leak occurred, and thereafter recurred at each feeding in decreasing quantity for about ten days, the last noted being on November 1st, twenty-three days after operation.

The wound was completely healed by December 1st, fifty-three days after operation. The patient has been able to take food in normal quantities without distress or regurgitation since the closure of the fistula.

Zenker and Ziemssen described pulsion diverticulæ of the œsophagus in 1877 and expressed the hope that some day operative treatment might be possible.

Judd, in 1918, reported thirty-five cases from the Mayo Clinic and stated that up to that time 150 cases had been reported in the literature.

Difficulty in swallowing, regurgitation of food, a feeling of an obstruction in the throat, a gurgling noise on swallowing in some cases; and later in advanced cases, a distinct loss of nutrition are the chief symptoms.

The majority of the cases are above forty-five years of age before symptoms lead to surgical treatment. The average age in Judd's series was fifty-five years. Palpable or visible tumor was present in ten of the thirty-five cases.

Of all the cases of diverticulum of the œsophagus operated upon by him, a one-stage operation was done in twenty-two cases; a two-stage operation in ten cases, and the Bevan operation of inverting the sac three times.

There were two operative deaths in the series, both aged men (seventy-three years and seventy-six years old), and bad risks—one after a one-stage, and one after the first step of a two-stage operation.

DR. WILLIAM A. DOWNES said that he had shown a case before this Society some ten years ago in which he had removed an œsophageal diverticulum. In that case he accidentally removed about one inch of the œsophagus and had to do an end-to-end suture. Only recently he showed the patient again with an accompanying röntgenogram and she has no constriction and the result has been perfectly satisfactory.

DOCTOR PECK said that he had remembered Doctor Downes' case when he was operating on this patient, and had profited by it to the extent of putting in a stomach tube as a guide. It is difficult when the diverticulum is drawn out to say where the œsophagus begins and the diverticulum ends. It is surprising how little one has left of the pedicle to turn in. A normal-sized stomach tube in the œsophagus is a help. If enough is left to invert there is not much to trim away. It would be difficult to do the operation, to carry out the careful suturing, under local anæsthesia. The drainage was kept well below the suture line.

## SARCOMA OF NASAL FOSSA

DR. CHARLES H. PECK, to show the late result, presented a patient who is well and free from recurrence eleven years after excision of a round-celled sarcoma of the left nasal fossa, involving chiefly the region of the middle turbinate and adjacent part of the ethmoid. The tumor had recurred twice after partial removal through the nostril. The diagnosis of round-celled sarcoma was made by Dr. Mortimer Warren from sections of tissue taken at the second operation and confirmed by examination of the growth after the radical operation by the same pathologist. The final operation was done by him February 7, 1919.

The mucous membrane of the maxillary antrum and frontal sinus was excised, but showed no involvement. The sphenoid cells were opened during the operation, but seemed normal. The nasal process of the maxilla, the left ethmoid and lachrymal (inner wall of the orbit): the inner wall of the maxillary antrum and a portion of the bony wall of the frontal and sphenoidal sinuses were removed.

The case was presented before this Society on March 22, 1911, and the operation reported in detail and published in the *ANNALS OF SURGERY*, vol. liii, 1911, p. 856.

Intratracheal anæsthesia was given by Dr. Chas. A. Elsberg, the first case in which it was used at the Roosevelt Hospital, and greatly facilitated the ease and safety of the operation.

The patient had long been lost track of and was thought to have died long ago. He was found by chance about four weeks ago, and is presented as a rather striking example of recovery from round-celled sarcoma after radical removal. He was forty-five years of age at the time of operation—fifty-six years at the present time. No post-operative treatment by toxins or X-ray or radium was ever used.

DR. ALEXIS V. MOSCHCOWITZ said that this is a very rare condition. He had operated on one such patient in 1917 and the patient is still without any recurrence. The speaker had used an incision different from that of Doctor Peck and the cosmetic result was beautiful. He used an incision going from the middle of the eyebrow down the bridge of the nose, so as to spread the nose; this gave a wide entrance to the ethmoid, enabling the easy removal of the tumor, and the resulting cicatrix was barely visible.

## THE SURGICAL VALUE OF THE ESTIMATION OF THE BILE PIGMENTATION (ICTERUS INDEX) OF THE BLOOD SERUM

DR. DE WITT STETTEN read a paper with the above title, for which see page 191, *ANNALS OF SURGERY*, vol. lxxvi, No. 2.

MR. ADOLPH BERNHARD (by invitation) said that when Doctor Stetten came to him last fall and asked him to take up the question of bile in the blood, he showed a very simple method for its determination. At the time this work had been confined to the medical side of the hospital and he had been greatly pleased to learn that a surgeon could get so much out of a simple laboratory test. The details of the test are simple. Blood is taken as for a

Wassermann and the serum compared with standard solution, dilution of the serum with salt solution being resorted to when the color is too dark for comparison. The delicacy of the test has been amply demonstrated by Doctor Stetten. One might compare the icterus index in jaundice cases to creatinine in the blood in nephritis. A rise in creatinine means a poor prognosis, a low creatinine a good prognosis. A rise in the icterus index would indicate an increase in the amount of jaundice; a fall in the icterus index means that the jaundice is decreasing. It is difficult to tell if jaundice is decreasing simply by inspection of the skin or sclera. There has been a fall of 40 points in the icterus index of a patient in whom no change in the sclera or the skin could be observed.

DR. ALLEN O. WHIPPLE was mostly interested in that part of Doctor Stetten's paper in which he referred to the determination of the amount of bile present in post-operative cases. He considered it very difficult to determine from the color of the patient's faeces or of the skin or sclera whether obstruction has been relieved, and yet it is very important to know if the common duct lumen is reestablished. That part of the test alone would make the work Doctor Stetten has done of very real value.

DR. HUGH AUCHINCLOSS asked if there were comparisons made with the blood concentration at the same time the tests were made. Many of these patients are dehydrated when they are first seen and then are given fluid in many ways. He wished to know if there is enough concentration of blood and decrease of body fluid to make an appreciable difference in the determination of the icteric index.

DOCTOR STETTEN, in closing, said that while various other comparative studies have been made, the special point that Doctor Auchincloss mentioned has not been taken into consideration. Most of these cases are not especially dehydrated and there had not seemed to be any occasion for studying the blood concentration in relation to the icterus index. An attempt, however, had been made to see whether cases with nitrogen retention showed increased bilirubinæmia due to poor elimination, but as yet no definite results have been obtained. A further effort had been made to find if there is any relation between the icterus index and delayed coagulation time, calcium deficiency, and hemorrhagic diathesis, but up to date the results have been very inconclusive and in some instances contradictory. Another problem that is being taken up is to see if the index determination will throw any light on that dread sequel to operation, namely post-operative cholæmic coma. It cannot yet be stated whether an excessive bilirubinæmia, an acidosis, due possibly to bile-acid intoxication, or merely an hepatic insufficiency, play the most important rôle in this not unusual complication.

#### SARCOMA OF THE SMALL INTESTINES

DR. JOHN DOUGLAS presented a specimen (Fig. 1) on which he commented as follows:

The surgery of a malignant disease brings with it many disappointments. Therefore a particularly favorable result, when the prognosis at the time of

operation seemed bad, is worthy of report if only as an encouragement to perseverance and the carrying out of as radical an operation as possible.

A man, thirty-six years old, was admitted to St. Luke's Hospital, December 23, 1916. He had been treated intermittently for lues for fifteen years. For eighteen months previous to admission he had indigestion, apparently intestinal in nature, with attacks of colicky pain at intervals. These attacks became more frequent and severe and the loss of flesh more marked. The day before admission he had a very severe attack and vomited. When seen before entering the hospital, his abdomen was distended, the distention being in the small intestine, and visible peristalsis was most evident, the coils of distended small intestine being plainly visible beneath the thin abdominal wall. In the right lower quadrant a mass could be palpated which felt as if there were an intussusception of the small intestine, rising up out of the pelvis with each peristaltic wave and disappearing as the muscular contraction ceased. A diagnosis of intestinal obstruction due to intussusception of the small intestine perhaps caused by a tumor was made, and immediate operation advised.

At operation there was found a tumor in the lower ileum infiltrating its wall so that the lumen was about five-tenths centimetre in diameter. Above this constriction the intestine was greatly distended, thickened, and œdematous. Below it was constricted and collapsed. Resection of the tumor, together with 10 cm. above and 4 cm. of the intestine below the growth with the mesentery attached, was done and an end-to-end anastomosis performed. A number of enlarged glands were removed from the mesentery.

The following is a description of the specimen removed:

*Macroscopical Examination.*—Specimen consists of a portion of the ileum from about its middle part measuring 16 cm. long by 5 cm. in diameter. The proximal portion is thick walled, leathery feeling, and at the distal part of the specimen is a white constriction band 2.5 cm. broad which when cut into shows a very soft homogeneous mass, projecting into the lumen. Within the central portion of the neoplasm is a small lumen slightly larger than a lead pencil and showing a mucosal lining. No ulceration is evident. (N. B.: Many nodes apparently involved were found at operation.)

*Microscopical Examination* (by Dr. F. C. Wood).—Section through tumor mass of intestine shows muscle wall which is infiltrated with lymphoid cells. Beneath this are masses of lymphoid cells and some soft reticulated stroma. Few blood-vessels are seen with indefinite walls. Some of the lymphoid cells are swollen. There are a few mitotic figures seen. Section shows a lymph-node with a decrease in lymphoid follicles and an increase in fibrous connective tissue. Some polymorphonuclear cells are seen. There are no mitotic figures.

Diagnosis: Lymphosarcoma of intestine (ileum). Lymph-node chronically inflamed. Possibly metastasis.

The post-operative course of this case was uneventful. He left the hospital three weeks after operation and a recent report in January,

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FIG. 1.—Sarcoma of small intestine. Note constriction below, dilatation above tumor and attempt at intussusception into dilated portion.

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1922, more than five years after his operation, states that he is in the best of health.

Sarcoma of the small intestine is of quite infrequent occurrence in comparison with the large number of cases of carcinoma of the large bowel. In 1912 he reported a case of sarcoma of the small intestine operated on in Bellevue Hospital. At that time the most complete analysis of the subject was the work of Lecène who had collected eighty-nine cases up to 1907. He was able to find only nineteen additional reported cases, including his own, up to 1912, a total of 108. In 1914 Speese made a careful analysis of the eighty-nine cases collected by Lecène and twelve additional cases from the literature, 101 in all. The most recent review of the recorded cases of sarcoma of the intestines by Goldstein, published in August, 1921, records 130 cases, including those in the large intestine and rectum; and as it is stated by Bottomley that 65 per cent. of intestinal sarcoma are found in the small intestine, the number of reported small intestine cases has not greatly increased. Its relative frequency in comparison with sarcoma of the stomach is shown by the fact that he was able to find 240 recorded cases of the latter in 1920 and Goldstein has collected 265 cases in 1921.

The relative occurrence of other tumors of the small intestine is shown by a paper published by E. S. Judd, who reports twenty-four cases of carcinoma of the small intestine compared with 1822 in the large intestine and rectum and 1689 in the stomach. Judd calls attention to the fact that the carcinomas of the small intestine differ from the ordinary carcinoma of the large intestine in that most of them develop on polypi or papillomata and in only a few instances followed the type of true colloid carcinoma usually found in the large bowel.

*Pathology.*—The types of tumor in the cases collected by Speese were lymphosarcoma thirty-four, round-cell forty-three, spindle-cell thirteen, fibrosarcoma three, myxosarcoma two, myosarcoma two, melanosarcoma one, and mixed type three. My own two cases not included in this list were lymphosarcomata. Both followed the type of infiltrating growth usual in lymphosarcoma. The small pedunculated tumors are generally of the spindle-cell type. The tumor is most frequently found in the ileum. As a rule the growths are single. Rarely multiple growths are present. Ulceration occurs in over half the cases, but cicatricial contraction, such as occurs in carcinoma, causing stenosis and obstruction, is uncommon. Intussusception is not infrequent. The accompanying illustration shows the effort of the intestine to produce an intussusception in the case reported. Perforation is rare but has occurred.

*Symptoms.*—The first symptoms noticed are usually the presence of the tumor in the abdomen, abdominal pains or discomfort. There may be intermittent distention, but complete obstruction is rare. When obstruction does occur, it is usually due to growths in the mesentery or to kinks or adhesions of the intestine. A small tumor causing intussusception may produce the first symptoms of the growth. Anæmia and cachexia appear quite early, the latter being the usual cause of death. Ascites is uncommon, as sarcoma does not form metastases on

the peritoneum as does abdominal carcinoma, although it may infiltrate the mesentery or omentum. While melena may occur, this is less frequent than in carcinoma because the growth is less likely to ulcerate.

This symptomatology differing, as it does from that of carcinoma of the large intestine, is what one would expect from the difference in pathology. In the reported cases the disease has occurred twice as frequently in males as in females.

*Prognosis.*—It is stated that the duration of illness in round-cell and lymphosarcoma is four to six months. In spindle-cell sarcoma, eight to ten months. The mortality of operation is high, but of course depends largely on the extent of the growth, the amount of infiltration, adhesions to other structures, condition of the patient, glandular involvement, etc. In the series of forty cases reported by Moynihan in 1906, it was given as 57 per cent. There was a mortality of 26 per cent. in the seventy-five resections collected by Speese in 1914. Bottomley writes that "recurrences" are almost certain to take place and Bondareff states that recurrence occurs in 95 per cent. of the cases of round-cell sarcoma, although he reports one case without recurrence for three years, and Steinthal records one free for three and a half years; also a case of spindle-cell sarcoma free for four years after operation. The reporter's first case operated on ten years ago was lost track of shortly after discharge from the hospital, although he had gained 22 pounds in the three months after operation.

The use of post-operative radiotherapy should prove of value in diminishing the percentage of recurrences, especially in lymphosarcoma, as this type of neoplasm in the superficial lymph-nodes at least seems one of the most amenable to this form of treatment. It is worthy of note, however, that the case reported free from recurrence for over five years received no radiotherapy or Coley's toxins after operation.

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*Stated Meeting Held May 10, 1922*

The President, DR. JOHN A. HARTWELL, in the Chair

#### ACUTE OBSTRUCTION OF SUPERIOR MESENTERIC VEIN

DR. DEWITT STETTEN presented a man, forty years of age, who on January 9, 1922, was operated on by Dr. Hermann Fischer for a huge retroperitoneal tumor below the left kidney. The tumor was



removed and a left nephrectomy was performed at the same time. Microscopical examination of the tumor showed it to be a carcinoma, possibly of testicular origin, although both testicles were normal and in the scrotum. The patient made an uneventful recovery and was discharged on February 7, 1922, with a superficial lumbar sinus. The patient rapidly improved, gaining thirty pounds in weight.

He was feeling perfectly well until 3 A.M. on March 14 when he awoke with severe abdominal pain and vomited. That afternoon he was admitted to the hospital. He had severe abdominal pain and vomited large quantities of bile-stained fluid. His temperature was 100° F., pulse 80 and good quality. There was slight tympanites and definite sensitiveness and rigidity in the right iliac fossa. Leucocytes 20,000 with 90 per cent. polymorphonuclears.

The following morning the patient's condition seemed to have improved. His pain was less severe, his vomiting had ceased and his temperature and pulse were normal. The abdomen was no more distended and the sensitiveness and rigidity on the right side had, if anything, diminished.

During the course of the afternoon the pain and vomiting began again and toward evening became more severe. The leucocytes had risen to 37,000 with 88 per cent. polymorphonuclears. That night the patient's condition changed decidedly for the worse. Although his temperature was still normal, his pulse had risen to 140, its quality thin and thready and his appearance was one of collapse. He was vomiting continuously and writhing in extreme agony. The distention had noticeably increased, likewise the sensitiveness and rigidity in the right side of his abdomen. No gas had been expelled and signs of peritonitic irritation were also evident on the left side.

With a tentative diagnosis of acute appendicitis and spreading peritonitis, operation was performed at 10 P.M. March 15, 1922 (43 hours after the initial symptom).

A right rectus incision was made. Before incising the peritoneum a bluish discoloration was noted beneath it. On opening the abdominal cavity, a stream of bloody serum under considerable pressure gushed out, and it was seen that a large quantity of this fluid was present in the abdomen. A somewhat distended loop of small intestine of a deep purplish-black color presented. Other loops in the neighborhood were examined and all showed the same discoloration. The appendix was not even searched for, but the cæcum was seen to be much contracted, slightly injected and reddish in color. A diagnosis of either a mesenteric thrombosis, torsion of the mesentery or strangulation of some sort was made, and a median hypogastric laparotomy was rapidly performed. With the exception of a small, high jejunal loop of about six inches in length, which, though somewhat distended, was of rather normal color, the entire small intestine showed the same discoloration as the loops previously examined through the appendix incision. An attempt was made to find a twist in the mesentery or a band constricting it. No actual twist of the mesentery could be found and the intestines

were then everted for exploratory purposes. Except for a small portion of the mesentery leading to the above-mentioned loop of comparatively normal jejunum, which was thin and felt and looked normal, the rest of the mesentery of the small intestine was densely infiltrated, at least one cm. in thickness, reddened, œdematous and hemorrhagic in spots. In places the ileum showed ecchymotic areas at points opposite the mesenteric attachment. Pulsation of the superior mesenteric artery was not noted, nor were any constriction furrows seen. The intestines were spread out in a fan-shaped fashion and nothing further was found. Nowhere could evidence of recurrence or metastases be detected. On the assumption that there was present a hopeless mesenteric thrombosis involving probably the circulation of almost the entire small gut, the intestines were rapidly replaced in what appeared to be their normal position. A suspicion of a change of color as they entered the abdominal cavity existed, the bluish-blackness seeming to have diminished a trifle, although not very definitely or conclusively. The abdominal wounds were rapidly closed under great pressure from the anæsthetist, the patient's condition having become very alarming in spite of stimulation and intravenous infusion. On several occasions the anæsthetist reported that the patient could scarcely survive more than a few minutes, that he had ceased breathing and was pulseless, but, in spite of this, the patient was brought back to bed still alive but in extreme shock. The usual stimulation, Murphy drip, etc., were ordered although it was felt that the prognosis was utterly hopeless. By the following morning the patient had improved considerably. His pulse was much better, he had had a bloody, diarrhœal stool, and his distention had subsided. His vomiting and pain had ceased; there was a slight rise of temperature. Stimulation and a 2½ per cent. glucose continuous intravenous drip were given. During the day the improvement continued. He expelled gas, his pulse steadily picked up, and toward evening he made the impression of a convalescent patient. On March 17 the patient's temperature had come down to normal, his pulse was 90, full and excellent quality. He had not vomited since the operation and his bowels had again moved spontaneously. His abdomen was flat, soft and insensitive. He took nourishment freely and all stimulation was discontinued. From this date on an uneventful recovery ensued with primary union of both wounds.

The only explanation of this rather unusual set of symptoms, according to the reporter, is the following: Owing to the growth of the large abdominal tumor the intestines with their mesentery had been pushed over to the right side of the abdominal cavity. Upon the removal of the tumor a defect existed which permitted the intestines to fall over to the left. From some sudden turn or twist on the part of the patient a kink occurred in the mesenteric radix which temporarily obstructed the return flow in the superior mesenteric vein. In the manipulations, while exploring intestines and the mesentery, he unwittingly corrected this abnormal position, replaced the intestines in their proper relation to the mesentery, straightened out the kink and relieved this venous obstruction.

## INTUSSUSCEPTION OF THE APPENDIX

DR. ALFRED STILLMAN referred to a case in which Doctor Peck had recently done a laparotomy. On opening the abdomen he discovered a mesenteric thrombosis, the whole gut being dark colored. He felt he could do nothing to relieve the condition and so closed the wound. Nevertheless the patient made a complete recovery.

DR. WILLIAM A. DOWNES spoke of a case which he showed many years ago before this Society, a child, whose abdomen on being opened was found filled with bloody serum and the entire small intestine had this same appearance as described by Doctor Stetten. It was considered to be a mesenteric thrombosis. As the entire small intestine was involved resection was out of the question. Thinking that a line of demarcation might be established and resection done later, the small intestine was brought out on the abdominal wall and covered with a rubber dam. Twenty-four hours later the natural color had reappeared and the intestine was dropped back and the abdomen closed. The patient made a perfect recovery. No doubt the child had some passing circulatory disturbance. These cases should be watched with great care and the treatment should be conservative.

DOCTOR STETTEN, in closing the discussion, said that cases had been reported of spontaneous recovery from mesenteric thrombosis (Klein, E., *Surgery, Gynecology and Obstetrics*, 1921, vol. xxxiii, p. 385), although these reports are all somewhat dubious. There is no question that the case presented was not an actual volvulus. No twist or strangulation of the mesentery or gut could be found. The lesion in the mesentery was very definite and marked. The mesentery resembled strongly that found in a strangulated hernia. It was felt that there had been a kinking of the root of the mesentery owing to the disturbed relations in the abdominal cavity due to the presence and later the removal of the retroperitoneal tumor. With this kinking the thinner walled vein was obstructed while the thicker walled artery apparently continued functioning, thus causing the intense venous obstruction of the gut and its mesentery. The kink and the obstruction were both relieved by the operative manipulation.

## INTUSSUSCEPTION OF THE APPENDIX

DR. CHARLES E. FARR presented a girl, now ten years of age, who on June 5, 1917, at the age of five years was brought to the hospital complaining of moderate pain, of four days' duration, in the left side of the umbilical region which at onset had been relieved by an enema. On June 4 she had vomited greenish fluid, and a local physician had found a lump to the left of the navel. The appetite was good, bowel movements normal, and she slept well. Physical examination showed a child quiet, almost apathetic, with a hectic flush, but not looking acutely ill. Head and neck normal, tongue slightly furred, heart and lungs normal. The temperature was normal, white blood-cell count 39,000, polymorphonuclears 80 per cent., urine negative, Von Pirquet negative. A diag-

nosis was made of intussusception and the patient was operated upon at once. There was no fluid nor were there any tubercles in the abdomen. The appendix and part of the cæcum was found invaginated into the ascending colon. It could not be entirely reduced and part of the cæcum was excised with the appendix. The wound was closed and the patient made an uneventful recovery. Microscopical examination of the specimen removed showed all coats œdematous, blood and lymph-vessels dilated and infiltrated with leucocytes. The lymphoid tissue was extremely hyperplastic and the appendix acutely inflamed.

DOCTOR FARR presented a second case of the same condition, also a little girl five years of age, who was admitted to the hospital March 31, 1922. She had been ill for five days with abdominal pain, and had vomited much greenish material and "phlegm" at onset. The pain was especially severe in the right lower quadrant and was intermittent, at times causing her to lie doubled up and unable to sleep. Temperature was found to be 98, pulse 110, respiration 28. The white blood-cell count was 10,600, polymorphonuclears 85 per cent., urine negative. In the right side of the abdomen could be palpated an indefinite mass, fairly well fixed. The child was not prostrated, but appeared toxic. Diagnosis of intussusception or appendicitis was made and operation was done at once. There was a little free fluid and the appendix was found invaginated into the cæcum exactly as in the other case. The constricting ring was dilated. The appendix was delivered with great difficulty and removed, the base being inverted. The wound healed with a slight stitch abscess.

In both cases the meso-appendix prevented complete invagination. The appendix was caught by the cæcum and could neither get in nor out. The result of non-operative treatment might possibly be a sloughing of the base of the appendix and the retention of the tip, but the danger of peritonitis would be very great.

DR. HUGH AUCHINCLOSS referred to a case of perfectly distinct intussusception of the appendix into the cæcum operated upon by Doctor Blake some years ago. A section was cut from it and the coats demonstrated inside out, the whole appendix lying inside the cæcum.

DR. HERMANN FISCHER spoke of a case of intussusception of the appendix that he showed before the surgical section of the Academy several years ago. The patient was a woman of about forty-two years of age who had a partial obstruction from a tumor of the transverse colon which was thought to be a carcinoma. On operation a colo-colic invagination was found. This could only be reduced to the point just above the cæcum which was very much thickened by œdema. The appendix which was very large, about the size of the lower ileum, was distended by thick mucus and half-way invaginated into the cæcum. This large mucocoele of the appendix was undoubtedly the cause of the invagination. The cæcum was resected and an ileocolostomy was done. The patient made an uneventful recovery.

## SUPPURATING ARTHRITIS OF THE KNEE

### SUPPURATING ARTHRITIS OF THE KNEE

DR. CHARLES E. FARR presented a boy, five years of age, who was brought to the hospital April 19, 1922. Four days previously he had fallen and cut his left knee on a broken milk bottle. There was swelling and pain and the child was unable to sleep. Temperature was 102.4°, pulse 108 and respiration 28, rising to 104°, 140, 30. White blood-cell count was 29,800, polymorphonuclears 88 per cent. on April 20th. A smear of the exudate from the knee showed many pus cells, cocci in pairs and short chains; culture showed a mixed growth of staphylococci and streptococci. Urine was negative. Operation, performed April 21, consisted of a long incision on either side of the joint, which was widely opened, allowing the escape of much pus and large fibrin clots. The joint was washed out. No drains were used and active motion was enforced from the very beginning. The result after nineteen days is a nearly complete return of function.

DR. DEWITT STETTEN said that recently he had had two cases of infectious arthritis of the knee which had been treated by mobilization, one, a metastatic pneumococcus infection and the other an extension from a staphylococcus osteomyelitis of the lower end of the femur. The pneumococcic case had been incised and drained and the other case had been punctured and irrigated. Both had been doing badly. When he put them on the Willems' treatment both rapidly recovered from their sepsis. As far as the mobility is concerned that is another problem. In neither of these two cases was the mobility entirely satisfactory, although both have a certain amount of motion. In the pneumococcic case there is a fixation of the patella and extension is practically nil, although flexion is rather satisfactory. Doctor Stetten proposes later to mobilize the patella. In the other case the patella is loose and there is moderate flexion and extension. What was most impressive was the rapid recovery from the sepsis. Both cases were free from fever within a week after the treatment was instituted.

DR. ALFRED STILLMAN said that there was, on the second surgical division at Roosevelt Hospital, a boy five or six years of age who had traumatic synovitis which became a suppurative affair and was incised on both sides of the patella. He was subsequently able to move the leg and got complete flexion. If these patients can be operated upon early enough it is possible to secure their coöperation in recovery of mobility.

DR. JAMES M. HITZROT said that while early motion was a very necessary thing in infections of the joints, from his experience the type of the infecting organism was more important in predicting the ultimate function, and the prognosis as to ultimate function depended upon the action of the infecting organism on the cartilage of the joint. Certain infections produce chondrolysis very rapidly. In these the prognosis is bad and ankylosis occurs. The staphylococcus aureus was particularly prone to produce early chondrolysis, while the hæmolytic streptococcus and other organisms produced little or no cartilage change in the early stages.

## MYOSITIS OSSIFICANS

DR. JAMES M. HITZROT presented a boy, aged sixteen, who was admitted to the New York Hospital, First Surgical Division (Cornell), September 21, 1921, complaining of pain in the right groin and inability to walk, due to the position of his right leg. The condition began two weeks before admission with pain on the inside of his right leg high up, then he began to limp and his leg became flexed at the hip. For about a week he had had to keep very quiet because the pain was increased by walking. There was no history of any definite injury, but at the onset he felt as if he had strained his leg, otherwise the history was negative.

On admission he looked fairly well, seemed comfortable as he lay in bed. His general examination was negative. In the right lower abdomen, extending down below Poupart's ligament, was a hard mass whose outlines could not be definitely defined. The leg was flexed, abducted and rotated out at the hip, and could not be fully extended. Active movements in flexion were almost complete. Internal rotation almost completely absent, external rotation practically absent. Forced movements in extension and rotation at the hip were painful. The thigh was atrophied. Motions at knee and ankle normal. Spine normal. With patient on his face, extension of right hip was markedly limited and quite painful.

Clinical Examination: Blood—red blood-cells 4,900,000, white blood-cells 7400, polymorphonuclears 63 per cent.; urine negative, Von Pirquet positive, Wassermann negative. X-ray examination negative; both sacro-iliac joints suggest some change, possibly due to infection. Vertebrae and hip-joint are normal in appearance.

The clinical diagnosis was a lesion of the iliopsoas muscle, possibly due to infection in the wing of the ilium.

October 20, 1921, a three-inch incision was made from the anterior superior spine of the ilium toward the symphysis. The tumor mass was found to be bone, cancellous in character, which extended up into the iliac fossa. The mass was then fully exposed and found to be a bony mass in the body of the iliacus muscle which extended to about one inch above the lesser trochanter. The mass was encapsulated and not adherent anywhere and was completely excised. Wound closed with small rubber drain at lower angle.

Convalescence was uninterrupted and the patient was discharged on sixteenth post-operative day. Extension of thigh now complete.

Four months follow-up notes: Movement at hip slightly restricted. Flexion complete. Extension limited to 10 degrees. External and internal rotation about one-half normal. Patient walks without limp or pain.

Pathological Report: Ossifying myositis with attached muscle fibres undergoing atrophy and interstitial changes. The mass was encapsulated.

## CARCINOMA OF STOMACH

DR. JOHN A. HARTWELL presented a woman, age twenty-five years, with the following history: In May, 1921, she suffered an acute attack of abdominal pain without previous symptoms, which was diagnosed

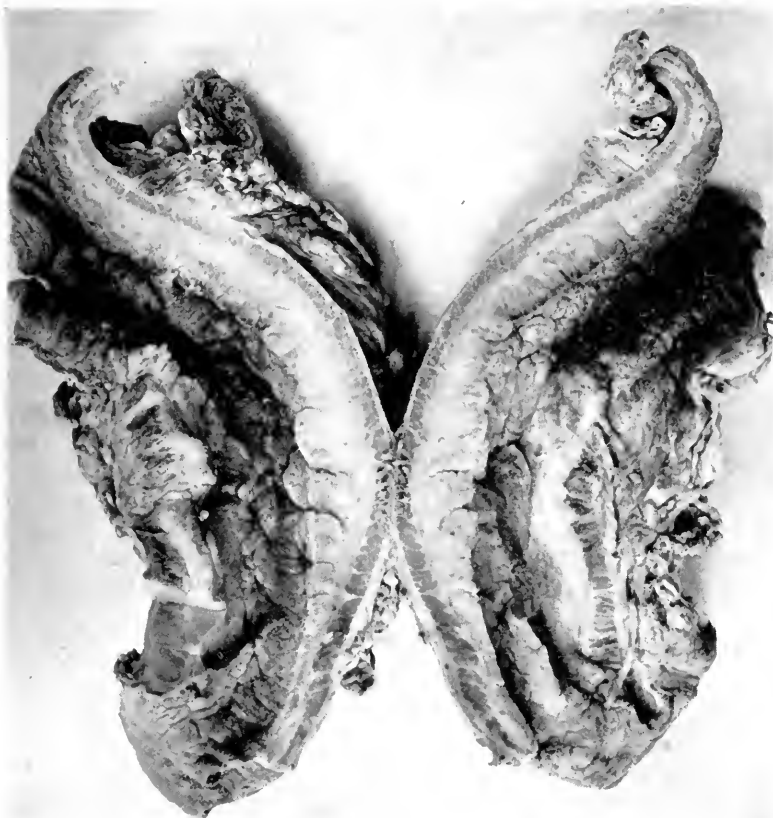


FIG. 1.—Diffuse carcinoma of stomach, showing portion removed at operation. Section obviously made through neoplastic tissue.





as acute appendicitis. An immediate appendectomy was done and no statement is made by the operator as to any examination of other organs. Following the operation the attacks of pain continued and to these were added intense pain on taking food with practically constant vomiting. At the time of admission to Bellevue she was able to take no nourishment whatever because of the very intense pain and persistent vomiting. She was markedly undernourished, weight 94 pounds, and very feeble. Examination showed a hard, cylindrical tumor extending from the left costal region to the pyloric region. Its diameter was about 3 inches and length 8 or 10 inches. It was of a stony hardness. The X-ray showed an involvement of the entire stomach by a rigid tumor mass; practically complete obstruction of the pylorus, but no dilatation of the stomach, owing presumably to the rigidity of the stomach wall.

December 16, 1921, the abdomen was opened. The stomach was found to be the seat of a diffuse carcinoma involving the entire wall of the stomach throughout its whole length up to the diaphragm. The process was, however, less advanced at the cardia than at the pylorus. Gastro-enterostomy, obviously, would have been of no avail, and it was therefore determined to remove as much of the stomach as possible by the Poliya-Reichel method. This was accordingly done, cutting through the stomach as high up on the cardia as possible, though it was obvious the section was through very marked disease. The gastro-jejunal anastomosis done so high on the stomach and in such a rigid organ produced a marked angulation of the jejunum. A jejuno-jejunostomy between the afferent loop and the efferent loop was therefore added.

Post-operative convalescence was entirely smooth. Food began to be taken at the usual interval without pain. At the present time the patient has gained 30 pounds; maximum weight having been 124 pounds. She is taking food without pain and without vomiting, and on physical examination there is no evidence of a mass in the stomach region. She has received two treatments of X-ray therapy at the Memorial Hospital.

The pathological report, Bellevue Hospital laboratory, is as follows: Gross—Specimen is a portion of the stomach from the pylorus to a point about 12 cm. proximally. The pylorus is apparently normal but just proximal to it there is a marked constriction. The wall of the stomach is thickened, measuring from one-fourth cm. to two cm. Much of this thickening is inside the muscularis and forms a white homogeneous, firm sheet, encircling the stomach. This layer appears at the proximal end of the specimen where it is quite thin (Fig. 1).

Microscopic: Diffuse carcinoma, quite cellular between and below the glands. Below this, islands of cancer cells (small but hyperchromic and irregular in shape) with much fibrous tissue. Muscular coat thickened and invaded by islands of tumor cells. Some invasions of the subserous layer. There are islands of fairly extensive colloid change.

The patient is shown because of the interest in the pathological specimen and the fact that temporary relief may be given in a condition

of this type. It is well known that this disease tends to an overgrowth of fibrous tissue with a destruction of the cancer cells, so that in many instances lesions removed at autopsy fail to show any remaining cancer. This has led to the name *linitis plastica* being given the disease and there has been some discussion as to whether it is always of a malignant type. The best authorities are now inclined to the belief that such is the case. The prognosis in this case is, of course, exceedingly grave, but it will be interesting to note the extent of relief afforded by the overcoming of the pyloric obstruction even though a considerable amount of cancer tissue remains.

DR. CHARLES N. DOWD said that as a side issue it was also interesting to note that this patient, before coming under Doctor Hartwell's care, had been operated upon for appendicitis without exploration of the upper part of the abdomen. Of course most surgeons now usually examine the upper abdomen when the abdomen is opened for other cause. It is not always appreciated that this exploration can be made through the intramuscular incision of McBurney if the outer part of the rectus sheath is cut, as was recommended by Weir. The entire hand can then be introduced into the abdomen and the gall-bladder, the duodenum and the pyloric end of the stomach as well as the head of the pancreas can be carefully palpated. Such palpation reveals pathological conditions from time to time, and prevents such undiscovered development as this case showed.

DR. JOHN F. CONNORS remarked upon the extensive involvement of a stomach with carcinoma one would get sometime before any symptoms were shown. Last month a man seventy-two years of age was seen by him who had been perfectly well with no gastric symptoms until the morning when he was stricken with a sharp pain, which was diagnosed as a perforated gastric ulcer. At operation it was found that the stomach from the pylorus to almost the cardia was involved with carcinoma, and his first symptom was the perforation which occurred on the anterior wall.

#### ADENOMA OF HEPATIC FLEXURE OF COLON

DR. JOHN A. HARTWELL presented a man, aged thirty-seven years, who was admitted to Bellevue Hospital, 2nd Surgical Division, September, 1921, suffering from an acute intestinal obstruction. The relevant history extends over a period of two months, during which time he had suffered from irregular attacks of abdominal pain, increasing constantly, and on one attack had passed a large quantity of blood by rectum. He had grown progressively more ill with the loss of a considerable amount of weight. Intestinal obstruction had existed as complete for three days and fecal vomiting was present. An immediate laparotomy was done by the Resident Surgeon which disclosed a neoplasm at the hepatic flexure of the colon and an immediate cæcostomy was done. The cæcostomy functioned satisfactorily. He gained in weight and there was a recession of the obstruction as shown by the passage of some fecal matter per anum. After six weeks the radical removal



FIG. 2.—Adenoma destruens of hepatic flexure.



of the tumor was accomplished. The usual procedure was followed of mobilizing the ascending colon with the tumor mass at its flexure. A portion of the colon from just above the cæcum to the middle of the transverse colon, with all the draining lymphatic system, was removed. A lateral anastomosis was made between the ileum, five inches proximal to the ileocæcal valve, and the transverse colon. It was decided to leave the cæcum *in situ* for two reasons: First, that the presence of the cæcostomy wound made its removal an additional hazard, and second, because the cæcostomy would act as a safety opening in case of œdematous obstruction at the site of the anastomosis, a well-known complication of this operation. It was hoped the cæcostomy would close spontaneously. This hope was not realized, as there was a small amount of fecal leakage from time to time through this opening. Three months later, therefore, it was decided to close the cæcostomy opening. This was done by freeing it from the abdominal parietes, suturing the opening in the cæcum and covering it with two layers of peritoneum.

The question was raised as to whether the ileocæcal valve would be sufficiently competent to prevent whatever fæces got into the cæcum from being re-expelled toward the ileo-colostomy. It was decided that this probably would not be the case. This decision proved to be erroneous. At the end of twenty-four hours the cæcum was enormously distended. The site of suture ruptured and there was a discharge of a large amount of liquid fæces and gas. It was obvious that the ileocæcal valve had proved completely competent.

The following day the fourth operation was performed. The cæcum and segment of ileum up to the point of anastomosis with the colon was removed. The patient has made a good recovery. Wounds are healed and solid and his general condition is rapidly becoming normal. Exploration of the abdomen at the time of this operation failed to show any evidence of recurrence of the growth.

He presented this case because of the interest attaching to the competency of the ileocæcal valve. The procedure of using the cæcostomy as a safety outlet with the hope of spontaneous closure is a recognized one. So far as noted the case is unique in the way in which the valve complicated the situation.

Pathological report on the specimen removed by Bellevue Hospital Laboratory is as follows: Gross segment of colon about five inches long in the centre of which is a slightly elevated ulcerated area two square inches in size. This area is about one-half inch in thickness, moderately firm and whitish. There are one or two pea-sized nodes along the colon (Fig. 2). Microscopic: Section shows growth to consist of irregular alveoli of large hyperchromic epithelial cells. In some places the basement membrane is defective. Interstitial tissue slight in amount infiltrated with round cells and a few polymorphonuclears. Muscularis beneath growth not incised. Lymph-nodes show inflammatory hyperplasia. No evidence of malignancy.

DR. CHARLES N. DOWD referred to a method for securing a vent for possible intestinal accumulation as described by Dr. Charles Mayo (*Jour.*

*A. M. A.*, Sept. 9, 1916, vol. lxvii, pp. 779-83). After removing the ascending colon an end-to-side union was made between the terminal ileum and the transverse colon. The purse-string suture in the proximal end of the transverse colon was so made that a vent could easily be secured through the abdominal wall.

#### THE DIAGNOSIS AND TREATMENT OF INCOMPLETE EPIPHYSEAL FRACTURES AT THE HIP

DR. ROYAL WHITMAN read a paper with the above title, for which see page 624. He also presented three patients, as follows:

CASE I.—A healthy boy eighteen years of age, first seen in September, 1920. About three months before he had fallen from a bicycle and afterward noticed some discomfort and stiffness about the right hip which had become practically disabling. In this case the limp was marked, as was the characteristic limitation of motion.

September 20, 1920. Under anaesthesia the restriction of motion was, in part, overcome and a plaster spica applied. A second attempt made in a week, and a third, a week later. On this occasion there was an audible yielding of the obstruction and a full range of motion was restored.

December 30, 1920. The plaster was removed and exercises begun. He had not been seen since, but a skiagraph showed his condition to be practically normal.

CASE II.—A healthy, well-developed girl twelve years of age, came to the hospital because of a limp and some discomfort in the left hip. There were the usual signs of slight outward rotation, and slight limitation of motion. First operation, September 16, 1920. Second operation, September 27, 1920. December 9, 1920, plaster removed. Complete recovery.

CASE III.—A rather fat boy. Was seen in November, 1921. He thinks he injured the right hip wrestling in April. Since then he has suffered increasing limp and discomfort. The deformity was reduced in November and the plaster spica finally removed the following April. He now has a full range of motion, but uses crutches.

#### FRACTURES IN CHILDREN—AN INVESTIGATION OF LATE RESULTS

DR. E. D. TRUESDELL read a paper with the above title.

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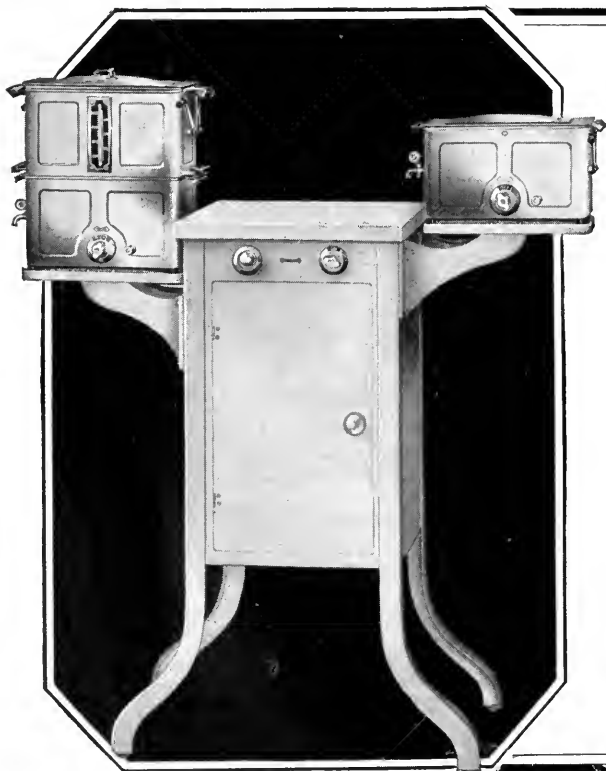
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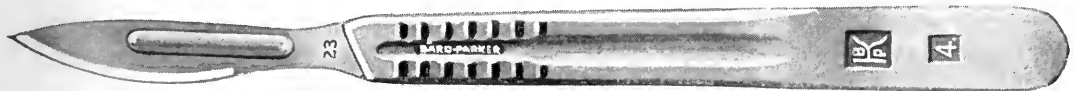


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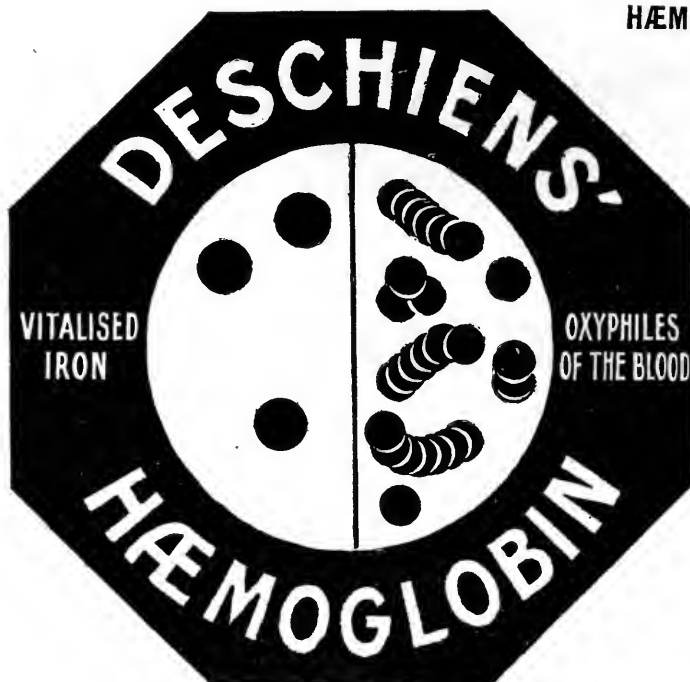
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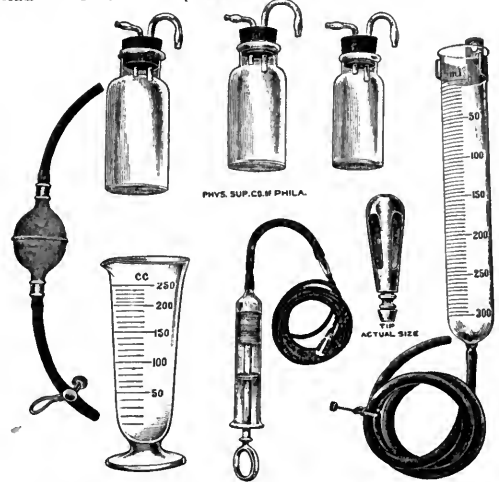
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**C**LAUSTRO-THERMAL, the improved method of heat sterilization, consists in applying the heat after closure of the tubes, thus avoiding all the chances of accidental contamination.<sup>1</sup> Sterilization by this positive method is made feasible by use of toluol as the tubing fluid, instead of the unstable chloroform.<sup>2</sup>

No other mode of sterilization so completely fulfills the exacting requirements for the production of ideal sutures as does the Claustro-Thermal method. It preserves the natural physical characteristics of the strands, while the destruction of all bacterial life is absolutely assured.

Claustro-Thermal catgut is aseptic though not germicidal. Not being impregnated with any bactericidal substance, it is inert in the tissues, exerting no inhibitive action.

These sutures are boilable. The tubes even may be autoclaved up to 30 pounds pressure for sterilizing their exterior preliminary to use. The heat sterilization procedure is described on the following page.

### VARIETIES OF CLAUSTRO-THERMAL CATGUT

Each Tube Contains Approximately Sixty Inches

Plain Catgut.....	No. 105
10-Day Chromic Catgut.....	No. 125
20-Day Chromic Catgut.....	No. 145
40-Day Chromic Catgut.....	No. 185

SIZES: 000...00...0...1...2...3...4

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Kalmerid catgut imbedded in agar infected with *Staphylococcus pyogenes aureus*



Iodized catgut imbedded in the same medium. Note the proximity of colonies

## Kalmerid Catgut

Antiseptic

**K**ALMERID CATGUT is an improved germicidal suture superseding iodized catgut.<sup>3</sup> It is not only sterile, but, being impregnated with potassium-mercuric-iodide—a double iodine compound—the sutures exert a local bactericidal action in the tissues.<sup>4</sup> It differs from the Claustro-Thermal catgut only in this respect.

The serious disadvantages of iodized catgut—deterioration, irritation, and impaired tensile strength—have been overcome through the use of potassium-mercuric-iodide instead of iodine. Unlike iodine, it does not break down under the influence of light or heat, it is chemically stable, and it is neither toxic nor irritating to the tissues. It interferes in no way with the absorption of the sutures, and is not precipitated by the proteins of the body fluids.<sup>5,6,7</sup>

These sutures are boilable. The tubes even may be autoclaved up to 30 pounds pressure for sterilizing their exterior preliminary to use. The heat sterilization procedure is described on the following page.

### VARIETIES OF KALMERID CATGUT

Each Tube Contains Approximately Sixty Inches

Plain Catgut.....	Boilable Grade.....	No. 1205
10-Day Chromic.....	Boilable Grade.....	No. 1225
20-Day Chromic.....	Boilable Grade.....	No. 1245
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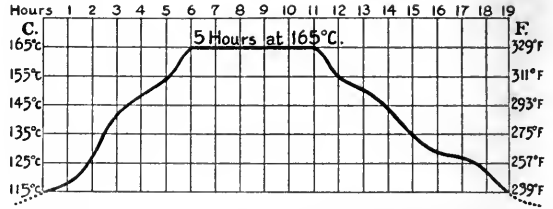
Kalmerid catgut is made also in an extra flexible grade, which is non-boilable, and which is described on the following page.

### GERMICIDAL EFFICIENCY AS COMPARED WITH IODIZED CATGUT

The marked inhibitory power of Kalmerid catgut, as compared with iodized sutures, is strikingly shown in these reproductions of culture plates. The lighter areas about the imbedded sutures represent zones of no bacterial growth, while the darker portions are masses of *Staphylococcus* colonies. It is evident that Kalmerid sutures exert in the tissues a far greater antiseptic action than do the usual iodized sutures.<sup>4,7</sup>

## Method of Sterilization

**B**OTH Claustro-Thermal and the boilable grade of Kalmerid catgut, described on preceding page, are subjected to the same sterilizing procedure: the sealed tubes are submerged in a bath of cumol and there exposed for five hours to the rigorous temperature of 165° C. (329° F.).<sup>1</sup> It is obvious that sterility is absolutely assured. Rigid bacteriologic control is maintained.



### Kalmerid Catgut—(Non-Boilable Grade) Extra Flexible

**T**HE NON-BOILABLE grade of Kalmerid catgut differs from the boilable variety described on the preceding page in that it possesses extreme flexibility—a characteristic sometimes desired by surgeons accustomed to the use of iodized catgut.<sup>7</sup> It is impregnated with potassium-mercuric-iodide, and the sutures exert a local bactericidal action in the tissues.

Potassium-mercuric-iodide is the double salt of iodine and mercury, the chemical formula of which is  $HgI_2 \cdot 2KI$ .<sup>6</sup> Through its use the serious disadvantages of iodized catgut—deterioration, irritation, and impaired tensile strength—have been overcome.<sup>3</sup> It is one of the most active germicides known, exerting a killing action on bacteria about ten times greater than that of iodine.<sup>4,5</sup> Physiologically it is bland and is entirely compatible with the tissues, not being precipitated by the proteins of the body fluids.

#### VARIETIES OF THE NON-BOILABLE GRADE OF KALMERID CATGUT

Each Tube Contains Approximately Sixty Inches

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20-Day Chromic....Non-Boilable Grade....No. 1445  
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They are genuine kangaroo tendons; they are smooth, straight, of uniform contour, and possess a tensile strength about twice that of catgut.

The tendons are chromicized, and so accurately is the process regulated that each size will maintain apposition in fascia or in tendon for approximately thirty days.<sup>8</sup>

Kalmerid kangaroo tendons are prepared in two grades—boilable and non-boilable. The latter are extremely pliable.<sup>7</sup>

#### VARIETIES AND SIZES

Non-Boilable are Product No. 370

The Boilable are Product No. 380

Each Tube Contains One Tendon

Lengths Vary From 12 to 20 Inches

STANDARD SIZES: 0...2...4...6...8

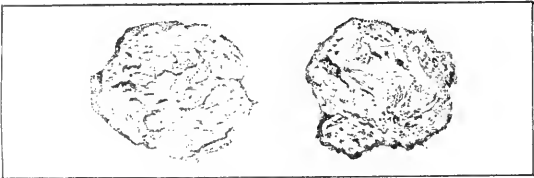
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#### THE PERMEATION OF KALMERID SUTURES BY POTASSIUM-MERCURIC-IODIDE



The lighter shaded specimen is a cross section of a strand of plain Kalmerid catgut, highly magnified.

The darker shaded specimen is a cross section of the same strand reacted upon by ammonium sulphid to precipitate the mercuric element.

The uniform color throughout the darker section shows the thorough permeation by the potassium-mercuric-iodide, the equable distribution of which assures a supply of this germicidal substance in the tissues until the suture is entirely absorbed.

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Product No.	Approximate Quantity in Each Tube	Standard Sizes
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360..Horsehair.....4 28-In. Sutures.....00		
390..Plain Silkworm Gut.4 14-In. Sutures...00, 0, 1		
400..Black Silkworm Gut.4 14-In. Sutures...00, 0, 1		
450..White Twisted Silk....60 In.....000, 00, 0, 1, 2, 3		
460..Black Twisted Silk....60 In.....000, 0, 2		
480..White Braided Silk....60 In.....00, 0, 2, 4		
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### Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
802..Plain Catgut.....20 In.....00, 0, 1, 2, 3		
812..10-Day Chromic Catgut..20 In.....00, 0, 1, 2, 3		
822..20-Day Chromic Catgut..20 In.....00, 0, 1, 2, 3		
862..Horsehair.....2 28-In. Sutures.....00		
872..Plain Silkworm Gut.2 14-In. Sutures.....0		
882..White Twisted Silk.....20 In.....000, 0, 2		

In packages of twelve tubes of a kind and size

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## Sutures With Needles

### Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
904..Plain Catgut.....20 In.....00, 0, 1, 2, 3		
914..10-Day Chromic Catgut..20 In.....00, 0, 1, 2, 3		
924..20-Day Chromic Catgut..20 In.....00, 0, 1, 2, 3		
964..Horsehair.....2 28-In. Sutures.....00		
974..Plain Silkworm Gut.2 14-In. Sutures.....0		
984..White Twisted Silk.....20 In.....000, 0, 2		



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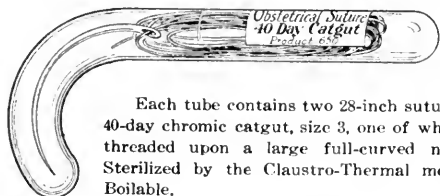
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Each tube contains a 30-inch suture of plain catgut, size 00, threaded upon a small full-curved needle.

In packages of twelve tubes

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## Umbilical Tape

### Heat Sterilized After Closure of Tubes—Boilable



Each tube contains two 12-inch ligatures of a specially woven flat tape one-eighth inch wide

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## Standard Sizes For All Sutures

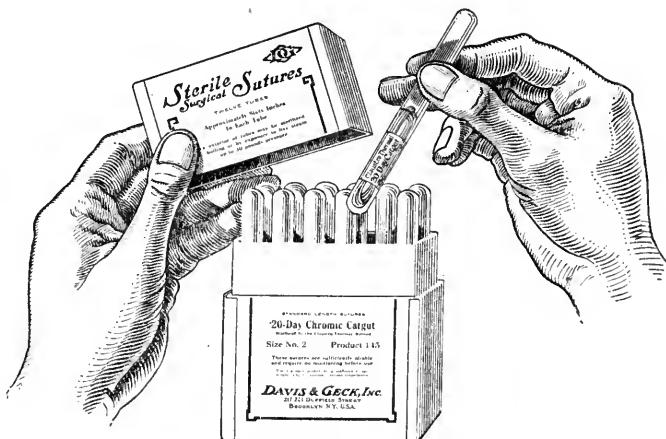
000	IN conformity with the long
00	recognized need for a
0	unified system of sizes, the
1	standard scale of catgut sizes
2	now embraces all sutures, in-
3	cluding kangaroo tendons, silk,
4	horsehair, silkworm gut, and
6	Pagenstecher's celluloid-linen
8	thread.

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- 10 ABSORBABLE ANIMAL LIGATURES. By Thomas A. Berryhill, M.D., Medical Director, United States Navy. U. S. Naval Medical Bulletin, July 1913.

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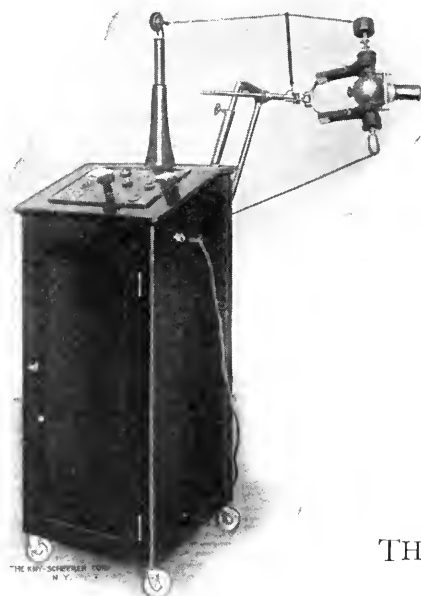
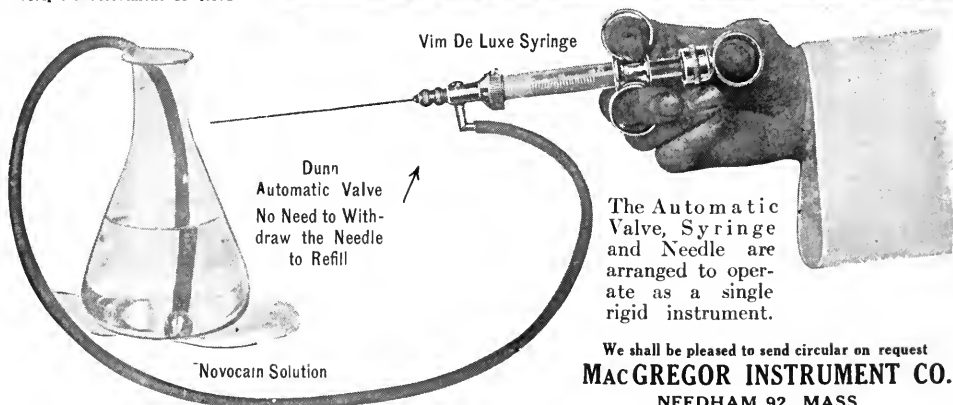
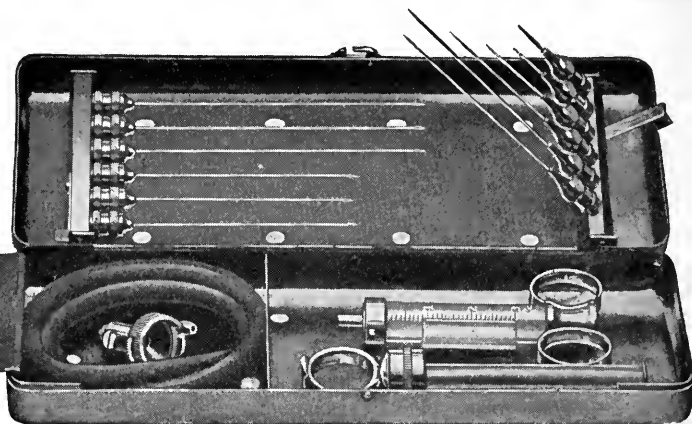
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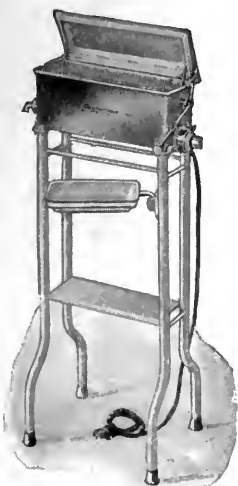
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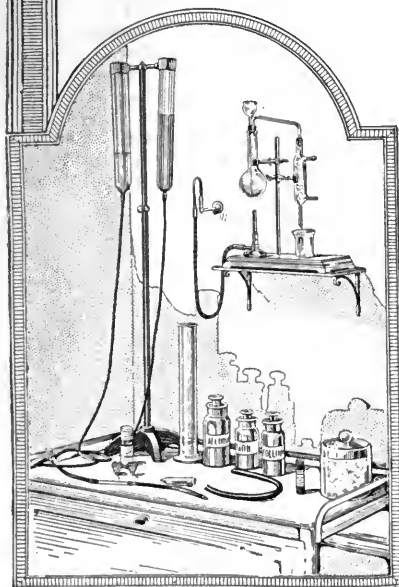
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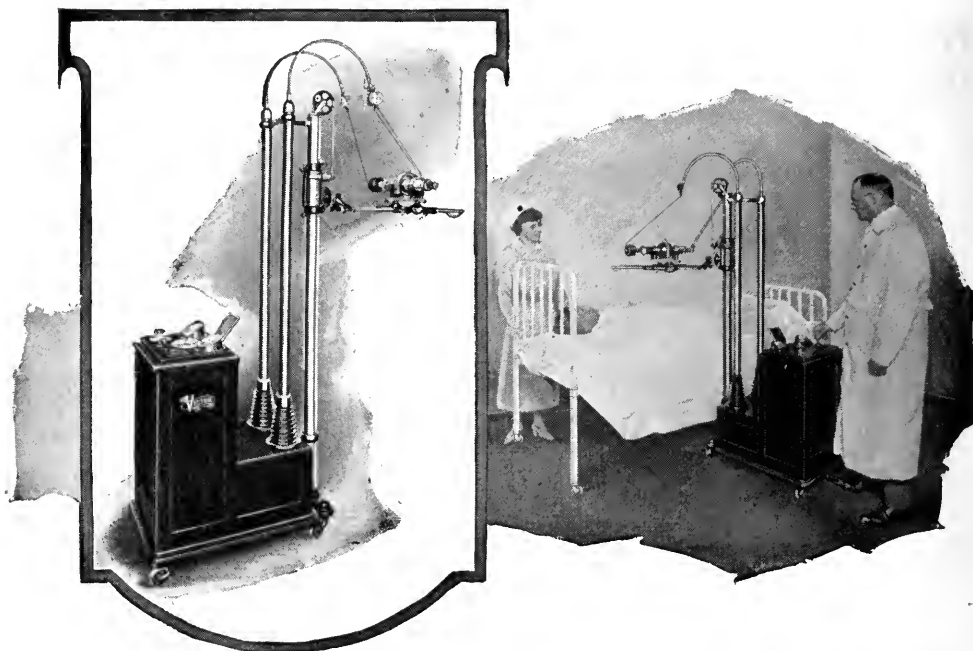
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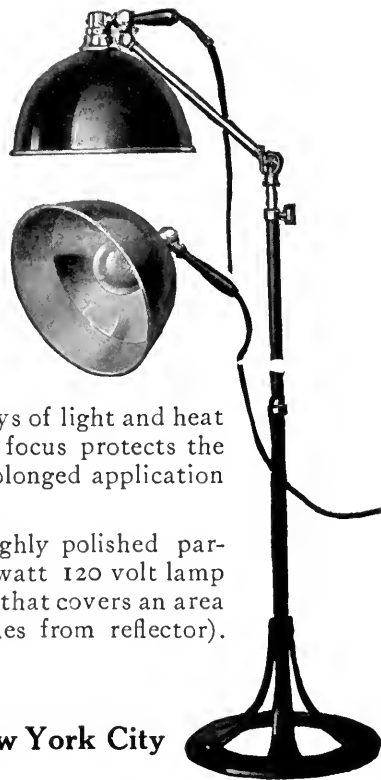
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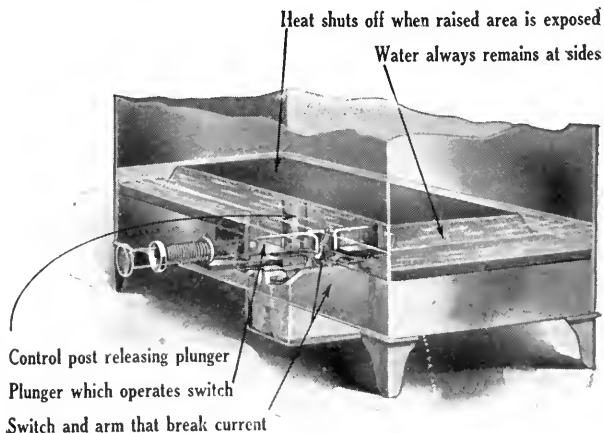
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# ANNALS *of* SURGERY

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## THE EFFICIENT TREATMENT OF ACUTE AND CHRONIC, SIMPLE, TRAUMATIC SYNOVITIS (HÆMARTHROSES AND HYDARTHROSES) BY REPEATED ASPIRATIONS AND IMMEDIATE, ACTIVE MOBILIZATIONS WITHOUT SPLINTING\*

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THE treatment of purulent infections of the knee by incision without drainage tubes, and immediate, active mobilizations, as advocated by Willems, has gradually and slowly displaced all other methods. This has only been accomplished by demonstration of the superb results obtained by this treatment in the numerous cases, met with in the late war, of severe infections of the knee-joint. The last word seems to have been spoken regarding the efficient treatment of infected knee-joints and we may consider the proper method of handling these severe lesions as definitely settled. This marks a great advance.

In civil life infected knee-joints are comparatively rare, in contradistinction to traumatic, simple effusions, which are very common, and which are badly treated in general, resulting in needlessly prolonged convalescences with subsequent disability and weakness. Most authorities still assert the necessity for immobilization with splints until the fluid disappears. Practically all the authorities which have appeared during the past two years have been consulted, and all but two insist upon the necessity of immobilization, while only two assert the advisability of evacuation of the fluid by aspiration. Thus, we find the following views: In 1907, Lovett expresses his idea of the proper treatment of acute, traumatic synovitis in *Keen's Surgery*, vol. ii, p. 300, and this plan of treatment remains with the majority of surgeons to-day the usual one, stereotyped as it were from one text-book to the other. Lovett says, regarding the treatment of acute synovitis, that "the most effective means at our disposal is rest to the knee-joint by the use of a splint made of wood, tin, or plaster-of-Paris. Fixation is continued until the fluid begins to subside, when measures to stimulate the local circulation are indicated. Massage, beginning in periods of fifteen minutes, given once or twice daily, is started as soon as the heat and extreme tenderness have disappeared, and continued until the synovial membrane is practically normal. If it irritates, it should be

\* Read before the New York Surgical Society, October 11, 1922.

stopped. Hot-air baking is useful from the outset, and should be given from thirty to forty-five minutes once a day. Douching, sponging, or packing with hot water are useful from the beginning, and, when the effusion has subsided, are more effective if followed by a cold douche. Compression to the joint when possible is obtained by a flannel bandage firmly and evenly applied over the splint. At first the splint should be removed only for the local treatment mentioned, and immediately re-applied. When the effusion has disappeared, restricted, but gradually increasing use should be allowed the protected joint. Unrestricted use is permissible only after the synovial membrane has become apparently normal, and use of the joint is not accompanied or followed by any serious amount of pain. Fixation must be continued long enough to quiet the inflammation of the joint, but not after that, for in the latter case muscular atrophy and a weak and irritable joint are favored." He also says that simple, chronic synovitis, which is merely the outcome of the acute condition, should be treated temporarily by fixation and compression, if symptoms of irritability are present, in order to regulate the circulation and diminish the effusion. Following this should come treatment by stimulating measures, which should be instituted as soon as effusion and irritability have diminished. These consist of massage, hot-air douches, and increasing and restricted use, as described in speaking of convalescence from acute traumatic synovitis.

It will thus be seen that the master word in this scheme of treatment is immobilization with various exhausting, physiotherapeutical, secondary accessories, all of which are unnecessary with the proper and efficient measures of treatment. There is no mention made of the necessity of aspirating the joint of the fluid. One would gather that the pain in the joint, on movement, is due to the lesion producing the fluid in the joint rather than to the passive presence of the fluid itself, as is actually the case.

This method, described by Lovett, was the generally accepted plan of treatment up to the time of the War. Let us examine various authors, who have written on the subject since 1919, to see whether the War taught anything in the treatment of these common lesions.

Albee, *Reconstructive Surgery*, 1919, p. 501, says that acute synovitis, the result of trauma, should be treated by rest of the parts, by elevation on a posterior splint and the application of an ice-bag. Nothing is said about the primary necessity for aspiration, except that "Aspiration may be practised if there is great discomfort from the tension." Of course it follows that if aspiration be not performed, immobilization is necessary because of the pain of the effusion. Remove the fluid and the movements of the joint are not only possible because almost painless, but very advantageous in promoting perfect future function. To my mind, even small amounts of fluid should be removed at the very outset of treatment.

Whitman, *Orthopædic Surgery*, 1919, p. 414, says that the patella floats when 30 c.c. of fluid are contained in the joint, the normal capacity being about 200 c.c. "Injury and its attendant synovitis may be treated, immediately, by splints, by elevation of the limb, and by the application of ice-bags. After the acute symptoms have subsided, the absorption of the effused fluid is aided by functional use of the limb, if the joint is properly protected by adhesive strapping. Aspiration

is always indicated if the tension of the effused fluid causes discomfort." Here Whitman evidently considers aspiration as a secondary and late, and, as it were, last resort method of treatment.

Mennell says in the *System of Orthopaedic Surgery of Injuries*, Jones, 1921, vol. ii, p. 549, that it is fatal to keep a case of simple synovitis of the knee at rest on a splint in bed till all the fluid has subsided, and then allow the patient to walk. Treatment by massage and mobilization should begin immediately after injury. A patient who twists his knee may be done up in a compression bandage and pad or in strapping and be allowed to walk forthwith. Mennell does not mention aspiration of the joint. How can a patient with a joint full of fluid, as the result of trauma, bend his knee? The mechanism of the joint will not allow it until the fluid is absorbed, which is a long, slow, tedious process.

Stillman, *Treatise on Regional Surgery*, Binnie, vol. iii, 1921, p. 490, says: "Locally, in the milder cases (serous or serofibrinous synovitis), complete immobilization by a plaster-of-Paris spica should be secured. When there is considerable exudate present, aspiration is often beneficial. It relieves the pain and removes the pressure on the inflamed capsule. Extension by weight, to keep the articular surfaces from pressing against one another, is desirable, but the weight should not be too heavy, else the inflamed and softened capsule and ligaments may be stretched. Fixation is continued until the signs of acute inflammation have subsided. When local heat and tenderness have subsided and the exudate begins to be absorbed, massage, compression by elastic bandage, and careful passive motion will hasten absorption. When the effusion has disappeared, restricted but gradually increasing use of the protected joint is permitted; but only after the synovia has apparently returned to its normal condition, and the use of the joint is not accompanied nor followed by any serious degree of pain, is unrestricted motion allowed. Prolonged fixation favors muscular atrophy, and renders the joint weak and irritable. If there is any doubt concerning the character of the exudate, an exploring needle should be used. If a purulent exudate is present, free incision, irrigation of the joint with normal saline, and the establishment of thorough drainage are essential." Regarding chronic serous synovitis (hydrops), he also says (p. 498): "If it is the result of acute synovitis, and pain and tenderness persist, traction and fixation are indicated. Compression by bandage, mild degree of counter-irritation and massage will hasten absorption of the exudate. In cases not influenced by these procedures, operation is indicated."

Moorhead, *Traumatic Surgery*, 1921, p. 166, says, regarding the treatment of acute synovitis, that: "1. rest; 2. immobilization; 3. function, are necessary. The joint (knee) should be put at rest with an ice-bag applied over it. It takes one to five days for the effusion, to reach its maximum, during which time pressure by a splint should be applied, tightening the outside bandage each day. When pain on pressure subsides (usually in two weeks) massage should be instituted. A week later walking may be allowed with adhesive plaster strapping. It is rarely necessary to aspirate the fluid in the joint. In chronic synovitis the fluid can be removed by any of the means suggested in the acute form until it is demonstrated that these pressure and rest objects are unattainable except by more drastic measures. Aspiration under perfect asepsis is then advised. To restore muscular tone and strengthen relaxed and shrunken soft parts, we employ massage, vibration and electricity and some motions that will not too severely tax the joint."

He finally ends by saying, "I have recently treated several acute cases by immediate aspiration, requiring the patient to actively move the joint after all the fluid has been withdrawn. Re-effusion is treated by re-aspiration. This procedure has very materially shortened the disability."

Billington, *Jour. Amer. Med. Assoc.*, 1922, Oct. 7, p. 1207, regarding the

treatment of acute, subacute and chronic traumatic synovitis, makes no mention of aspiration but applies a plaster-of-Paris splint, according to old orthodox lines of treatment.

Fay, *Surgical Diagnosis and Treatment*, 1922, Ochsner, vol. iv, p. 710, says: "Traumatic synovitis is at once the commonest and the most benign lesion of the knee resulting from injury, and under this term we may classify all effusions into the knee in which injury to the ligaments, the semilunar cartilage and the patella can be excluded. The stability of the joint is not affected unless very extensive effusion has resulted in temporary stretching of the ligaments, but there may be considerable pain and tenderness. The condition should be treated immediately by rest and cold applications, and, as soon as pain and tenderness have subsided, judicious exercise should be urged to aid in dispelling the effusion. In the occasional case in which the condition becomes chronic, elastic pressure and moderate use of the joint will usually effect a cure."

The *Oxford Index of Therapeutics*, 1921, p. 865, advises tight strapping, which immediately arrests the effusion and brings about absorption, at the same time prevents stretching of the ligaments; he advocates *passive* movements within twenty-four hours and *active* movements in two or three days. No mention is made of aspiration of the fluid. How one is to make passive movements in a joint distended with fluid is not mentioned. Movements of a distended joint decrease its capacity, and, as the fluid is non-compressible, movements to any extent are not only very painful but are impossible as long as the joint contains fluid.

H. S. Taylor says: "A simple synovitis should recover in three to six weeks." Under the treatment by repeated aspirations and active mobilizations, such a case should be well in from ten days to three weeks.

Cotton, *Surg. Clin. North America*, August, 1922, 1023, in an exhaustive article on knee lesions, makes no mention of aspiration. He says: "The ordinary synovitis cases ('water on the knee,' resulting from almost any blow or twist or strain), treated by plaster-of-Paris or splints, shows a very early *selective* degeneration and atrophy of the rectus portion of the quadriceps muscle. Such atrophy promptly leads to a lax joint and perpetuation of the synovitis (better and then anon occurring) for several months under the usual routine (*i.e.*, splinting). Under adequate but trained (and restrained) massage of joint and muscle, the fluid goes, the muscle does not dwindle and one saves several weeks at least. There is no reason why a synovitis case cannot go about without crutches, but they should use a stout cane. Synovitis cases should be—though often they are not—well after about six weeks." Cotton uses straps, bandage, massage and supervised exercises. The author would suggest that were immediate aspirations of the fluid added to Doctor Cotton's procedures, the duration of the disability would be cut at least one-half, in which case also the other physiotherapeutic measures would be unnecessary, an important point in the management of hospital patients.

Mobilization was the idea of Lucas-Championnière forty years ago, and we have been gradually coming more and more to its adoption, but aspiration of the fluid was foreign to his conception. Then John B. Murphy advocated repeated aspirations, to be followed afterwards by absolute immobilization with traction. Now it would seem that with all our war experience behind us aspiration *without* mobilization is incorrect. The most efficient method of treatment appears to be the combination of repeated aspirations with immediate mobilizations (walking and *active* movements) without splinting. It took the genius of Willems to combine these two methods, and to him we owe a great debt of gratitude for having given us a most satisfactory, rapid, and

efficient method of treating these obstinate lesions. Willems says (*Surg., Gyn. and Obstet.*, 1919, June, p. 546): "It is now some years since my attention was directed to this problem (traumatic joint effusions), and I have freed myself by degrees from practicing the law of immobilization. I have commenced with evacuatory punctures to drain traumatic effusions of the knee, hæmarthroses and hydarthroses, and by making the patient walk immediately. Not only could they do this without any difficulty, but their lesions cured in a few days without leaving any trace. My method of treating traumatic effusions by puncture, followed by immediate movements, was rapidly adopted by practitioners, dealing with industrial accidents, owing to the great rapidity and perfection of the recovery and also owing to its great simplicity." Willems and Murphy are the only two authors who maintain, as the primary requisite of proper treatment, aspiration of the joint.

The increased secretion of synovial fluid is the result of nature's attempt to float apart the two inflamed surfaces. Distention produces stretching of the ligaments with subsequent weakness of them. Pain caused by attempts at moving a distended joint, together with decreased circulation, consequent upon pressure, due to the fluid, produce quickly flabbiness, weakness and even atrophy of the muscles. Synovial fluid is more slowly absorbed than it is secreted, but, when the fluid portion is absorbed, a gelatinous residue is left which coagulates. This coagulum may organize, producing adhesions with its consequent partial or complete ankylosis. In addition, small particles may be broken off the coagulum and become loose in the joint, producing the so-called "rice-kernels." Hence the effusion should be removed at the earliest possible moment after the injury so as to prevent the formation of this coagulum, and the joint should be kept free from fluid by repeated aspirations subsequently, even as often as every second or third day.

The pain attendant upon any movement of an acutely distended joint is agonizing. It is surprising how immediate is the disappearance of pain after aspiration of the fluid. As the fluid subsequently reaccumulates, pain returns, to be immediately relieved by subsequent aspirations. This gives the key to the treatment. The aspirations should be repeated as often as the fluid reappears. Combined with the aspirations should be active, but not passive, motions of the joint with walking begun immediately after the aspiration. If there be a sprain of the joint, strapping may be applied so as not to restrict the motions too much. If there be lateral mobility, a hinged lateral brace should be fitted which prevents twisting and lateral strain but allows normal flexion and extension of the joint. The motions are only active because with these, pain will prevent their being carried so far as to produce additional lesions; passive motions, on the other hand, are blind, and therefore are not permissible because of the danger of their being performed too vigorously, thereby increasing the effusion of blood and synovial fluid because of the additional lesions caused thereby.

The simplicity of the after-treatment is its great advantage, together with the rapidity of the convalescence. There need be no artificial massage,

bakings, passive motions, nor any other physiotherapeutical means, save possibly an ice-bag, since the active motions produced all the effects artificial massage accomplishes. Aspiration of the knee is as simple and innocuous as aspiration of the chest. Tincture of iodine and a sterile aspirating needle are all that are necessary. The needle is inserted, without touching its point with the fingers, one inch to the inner side of the patella just above its lower border. It is inserted outwards and upwards and its point comes to lie behind the patella and between the tibia and fibula. If aspiration be done soon after the injury, the effused blood will not be too thick to be aspirated through a fair-sized needle. Hence aspiration should not be the last resort, but the first to be done, since it may be impossible to draw off the coagulum which later results. There need not be the slightest fear of infecting the joint if ordinary aseptic precautions be adopted. One does not hesitate to aspirate a chest through fear of infection and the same should be true of the knee-joint.

With repeated aspirations and active movements of walking, a patient with an acute, traumatic synovitis should be well in from ten days to three weeks, with a painless, perfectly functioning joint, instead of the usual time of from three to six weeks, with a weak, tender joint with the liability to a recurrence of the fluid. The idea of the necessity of immobilization in traumatic synovitis seems to have so firmly imbedded itself in the surgical consciousness that dislodgement of it would seem almost impossible. The first thing necessary is for authorities who write text-books to cease advocating this obsolete method, then gradually the practitioner will take up the better procedure. Stress should be laid on the preliminary necessity of aspiration of the fluid from the joint in order that pain may be lessened and immediate mobilization may be rendered possible, following which aspirations should be repeated as often as necessary to keep the joint free from fluid.

The following patient illustrates the acute condition. A well-to-do man of forty-five years of age was playing tennis in the country, on April 16, 1922, when suddenly he twisted his right knee and fell. He managed to get to a neighboring house and came to town, when he was seen by the author late that night. His temperature was  $101^{\circ}$ , and the right knee was very painful on motion, containing a slight effusion. There was no dislocation present nor any abnormality in the position of the bones of the joint, nor could any joint mouse be felt. There had never been any previous trouble with the knee. A tentative diagnosis was made of a sprain of the knee. The joint was strapped and an ice-cap applied over the strapping. The next morning the joint was tense with effusion, and it was aspirated, six tablespoonfuls of fluid blood, mixed with synovial fluid, being obtained. Any motion in the joint, prior to the aspiration, was impossible because of the exquisite pain caused thereby, but, after the aspiration, active flexion could be made to the extent of  $25^{\circ}$  without much pain. He was instructed to make active flexion every two hours, in bed, to the greatest extent possible. The temperature for one week ran  $101^{\circ}$  in the afternoons, due probably to the effused blood. On the third day he was allowed up and was given crutches and told to put weight on the knee, and to flex it as much as possible without causing pain. On the fourth day, the fluid had re-accumulated, so another aspiration was performed, obtaining four tablespoonfuls of less thick blood and synovial fluid. On the seventh day, he



## TREATMENT OF TRAUMATIC SYNOVITIS

walked without crutches. Subsequent aspirations were done on the tenth, fourteenth and eighteenth days. All except the last aspiration were bloody in gradually decreasing amounts and quantity. At the last aspiration, only one tablespoon of clear synovial fluid was obtained, and he was walking as usual without support, having been at his business since the seventh day. He was well on the twenty-first day. Six weeks later he wrote that he was riding horse-back, walking and swimming without discomfort or weakness. One great advantage of aspiration is the ability it provides of determining whether the joint contains a joint mouse or a dislocated meniscus, since motions are so much freer and carried out with so little pain when the joint is free from fluid, rendering palpation very easy. Other great advantages of this treatment, combining repeated aspirations with active motions, are the simplicity of the after-treatment, the little restraint necessary, the quickness of the cure, as well as the perfect, final, functional result.

### CONCLUSIONS

1. Repeated aspirations combined with active (never passive) motions, and walking without splints afford the best method of treatment of acute and chronic, traumatic, joint synovitis, provided there be no joint mouse nor dislocated meniscus present.
2. Aspiration should be *immediately* performed in all types of traumatic joint effusions as it relieves pain immediately, renders a correct diagnosis more certain, prevents stretching of the ligaments with their consequent weakening, and avoids subsequent muscular atrophy.
3. Such treatment makes unnecessary all other subsequent physiotherapeutic measures, hence its simplicity makes it applicable to all classes of patients.
4. Such a method of treatment produces a more perfect cure in one-half of the time that is required by the old immobilization method.
5. To leave fluid in a knee, the result of trauma, is just as irrational as to leave fluid in a chest unaspirated.
6. Aspiration of a knee is a simpler procedure and less dangerous than aspiration of a chest, and can safely be performed in a doctor's office or a dispensary, and the patient thereafter can be immediately sent home walking.
7. The effects of physiotherapeutical measures have been overestimated, being used empirically and without foundation. They are makeshifts to excuse procrastination in not applying a radical, curative procedure such as aspiration.

## A METASTASIZING MALIGNANT TUMOR OF THE THYROID GLAND

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THE thyroid gland continues to claim the interest of many branches of medicine because of the secrets still hidden in its physiology and pathology. The clinical entities of exophthalmic goitre and toxic adenoma have become fairly well established as a result of the work of Kocher,<sup>8</sup> Plummer,<sup>12</sup> Wilson,<sup>18</sup> and others. Also the histological picture of exophthalmic goitre

is quite definitely understood and quite clearly differentiated from the other pathological conditions, thanks to these observers as well as to MacCallum,<sup>10</sup> W. S. Halsted,<sup>7</sup> and Bloodgood.<sup>2</sup> The microscopic picture of toxic adenoma is less clearly understood because of the difficulty of demonstrating the portions of the tumor giving rise to the toxicity. It may be that further observations will confirm the theory suggested by Goetsch<sup>5</sup> that the physiological or pathological activity of the tumor cells may be made evident by mitochondrial stains. Cysts have been satisfactorily accounted for and described by Bloodgood.<sup>3</sup> Colloid goitre, having received almost universal recognition by reason of its geographical distribution,



FIG. 1.—Photograph of patient after the removal of a gland from the left posterior triangle for diagnosis.

still baffles medical science with regard to its cause and prophylaxis, although Marine and Kimball's<sup>11</sup> work seems to be particularly promising. The histology is quite definite.

The other tumors of the thyroid, however, ranging from the fetal adenomas and simple adenomas to the malignant and metastasizing tumors, are still unsolved clinical and pathologic problems of the greatest interest and importance.

Langhans,<sup>9</sup> in 1907, pointed out that the histological picture of the malignant tumors of the thyroid differed widely from the typical

carcinomas of breast, stomach, lip, etc., and believing that the term carcinoma was not sufficiently clear or definite, made a new classification. He admitted, however, that sometimes the various forms which he described merged into one another and that the classification was difficult at best. Wilson<sup>16</sup> has recently had the opportunity of presenting a large series of cases of malignant tumors of the thyroid. Although he has gone a long

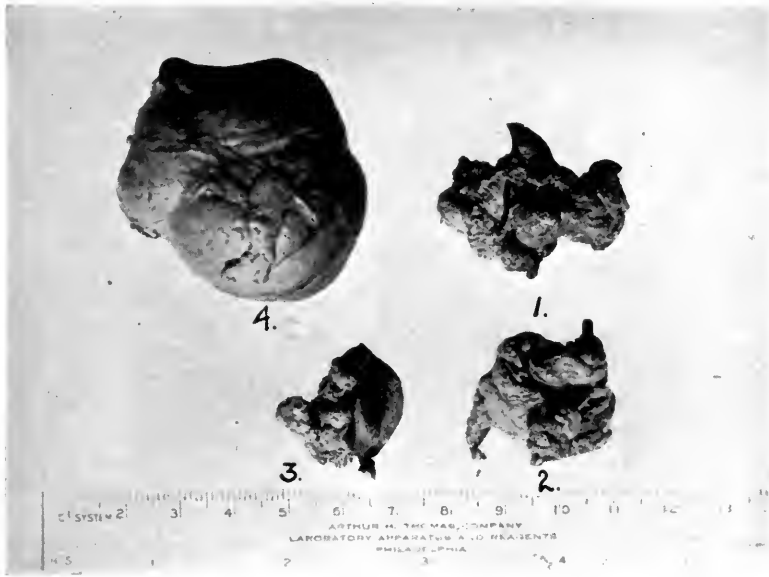


FIG. 2.—Specimens removed at main operation in their relative anatomical positions: (1) from the thyroid gland, (2) from the sternothyroid muscle, (3) from the lower jugular gland, (4) from the main jugular gland.

way in clearing up some of the difficulties, he still admits that the differentiation between the benign and malignant tumors is often clinically impossible and pathologically extremely difficult. He decries the fact that there are not more data available, and has pointed out that there are probably many cases which have never been reported which could materially add to our knowledge of the subject.

It is with this in mind that I would like to present the following case and discuss its features, briefly, in the light of the recent literature regarding thyroid tumors.

CASE RECORD.—Hospital No. 1455. Name, Wu Chao Tau. Nationality, Chinese. Sex, male. Age, eighteen, Chinese reckoning (this in Western reckoning would be seventeen, because the Chinese count the year in the womb and call the child one year old on the day that he is born). Admitted January 11, 1922.

*Chief Complaint.*—Mass on right side of neck—duration six years.

*Present Illness.*—*Swelling:* Began six years ago as a small, firm nodule beneath the right sternomastoid muscle—gradual, but continuous growth of this

single mass with the later appearance of one below and one above the original and another in the posterior triangle. During the last two years a gradual development in the same manner of three others on the left side. None noticed in front. *Dyspnea*: Gradual development during past year and now quite distressing. Slightly worse on lying down. *Cough*: Dry and unproductive during last few months. *Dysphonia*: Gradually developing with cough. *Dysphagia*: None noticed. *Pain*: None. *Fever*: None. *Loss of Weight*: None. *Loss of Strength*: Only

in so far as breathing is difficult. No other functional disturbances. No general nor special sense symptoms.

The personal history, past illnesses and family history may be omitted because they are irrelevant.

January 11, 1922. Admission Note: Boy of eighteen (Chinese reckoning), somewhat undersized. Round face, bright and intelligent, but anxious. Well nourished, sitting up in bed, gasping for breath and pressing with expiration as if there were considerable obstruction to the intake and output of air. He has a dry and brassy cough. Voice is husky. The neck is greatly swollen (Fig. 1). There is a large mass about the middle of the right sternomastoid which seems to push that muscle backward, probably flattening out its anterior fibres. It measures about 6 by 6 cm. There are two smaller masses, one above and one below the main mass, and one in the posterior triangle above the clavicle. There are three similar ones on the left side, two in the posterior and one in the anterior triangle. The right lobe of the thyroid seems to be slightly enlarged and several firm nodules are felt along both sides and in front of the trachea which all move upward on deglutition. These central masses are more or less confluent, but the lateral masses are all discrete. The skin moves freely over them. They are not firmly attached to deeper structures. They are elastic and non-tender. The manubrial dulness is widened slightly. Axillæ and inguinal regions negative. Liver and spleen not palpable. Rest of physical examination negative.



FIG. 3 (a).—Photomicrograph  $\times 100$  from the left posterior triangle gland, showing lymphoid tissue and vesicle formation.

that muscle backward, probably flattening out its anterior fibres. It measures about 6 by 6 cm. There are two smaller masses, one above and one below the main mass, and one in the posterior triangle above the clavicle. There are three similar ones on the left side, two in the posterior and one in the anterior triangle. The right lobe of the thyroid seems to be slightly enlarged and several firm nodules are felt along both sides and in front of the trachea which all move upward on deglutition. These central masses are more or less confluent, but the lateral masses are all discrete. The skin moves freely over them. They are not firmly attached to deeper structures. They are elastic and non-tender. The manubrial dulness is widened slightly. Axillæ and inguinal regions negative. Liver and spleen not palpable. Rest of physical examination negative.

*Opinion*.—The gradual growth of the tumor and gradual development of pressure symptoms, the rather extensive distribution of discrete, freely movable glands, with peritracheal involvement and with probably some mediastinal involvement in a boy of this age, seem to point strongly to Hodgkin's disease, although in this land of tuberculosis that must be kept in mind. Other considerations are lymphosarcoma and thyroid tumor, which are not so likely, I think, because of the boy's age and the manner of development of the swellings.

## METASTASIZING THYROID TUMOR

*X-ray Report.*—The shadow of the soft tissues of the neck is very dense and extends down into the upper mediastinum as a dense shadow. Lungs apparently clear.

A gland from the left posterior triangle of the neck was removed for pathological examination under local anaesthesia. Dr. J. P. Webster made this observation in his operative note: The large gland which was sought, lay quite deep. It was found to be very vascular with an abundant blood supply from the under surface. Some of the vessels nearly as large as a straw. It looked very much like thyroid tissue.

With interest now directed to the thyroid, the following notes were added to the local description given above. There is fullness in the midline below the thyroid cartilage, more marked on right than on left. The principal mass on the right side has a slightly expansile pulsation. A strong systolic thrill is felt over the lower and inner border of the right lobe of the thyroid and a loud systolic bruit can be heard especially at this point, but also throughout the entire mass. No thrill nor bruit on the left side. In the suprasternal notch there is a hard, round, smooth mass 2 cm. in diameter. The neck measures 42 cm. at the level of the thyroid cartilage, 40.5 cm. at the base of the neck and 40 cm. midway between. Eyes normal. No fine tremor. Pulse regular, rate 88. Genitals normal, but pubic and axillary hairs absent (this is fairly common at this age with the Chinese).

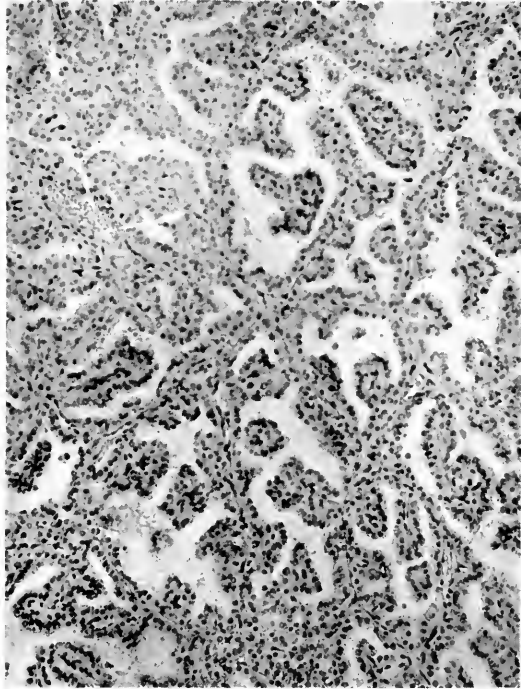


FIG. 3 (b).—Photomicrograph  $\times 100$  from the same gland, showing papillary formation.

Pathological report from excised gland. Metastatic carcinoma of the thyroid (detailed below).

Goetsch test faintly positive. Blood-pressure rose six points after ten minutes and pulse ten points after twenty minutes. Slight subjective throbbing after seven and a half minutes. No other signs nor symptoms.

Basal metabolism test 45 per cent. above normal. Patient not very coöperative—result unreliable. Second basal metabolism test 39 per cent. above normal. Patient more coöperative.

Operation by Professor A. S. Taylor. Partial thyroidectomy and excision of lateral tumor. Great venous trunks were encountered immediately beneath platysma. The main tumor mass lay beneath the middle of the right sternomastoid, which had to be cut. On the tumor surface there were many large thin-walled blood-vessels. The thyroid gland was firm and contained many very hard nodules. It was bound firmly to the trachea. The lower extremity of the

mass could not be reached because it extended into the mediastinum. Extreme hemorrhage was encountered. Considered unjustifiable to attempt complete removal. A wedge-shaped portion of thyroid tissue was removed from the right lobe and a firm nodule removed from the substance of the right sternothyroid muscle. The main mass on the right and a smaller mass below it were removed. During this procedure the large thin-walled vessels bled profusely.

Considerable respiratory difficulty. Temperature up to forty degrees C.

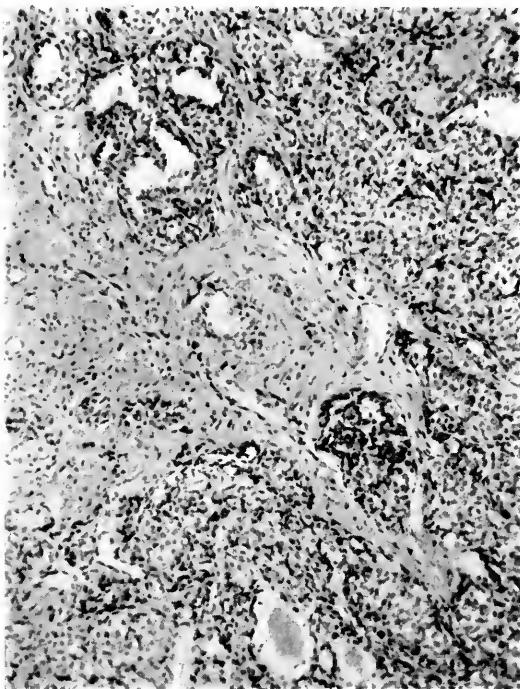


FIG. 4 (a).—Photomicrograph  $\times 100$  from the sternothyroid muscle, showing invasion of the muscle by tumor cells arranged in solid masses and papillary processes.

return for examination. We have indirect news from him to the effect that for a time his health was greatly improved and there was no evidence of growth in the neck. Within the past month, however, five months after operation and X-ray treatment, although his general health is good, the swelling of his neck is increasing.

*Pathological Examination.*—(A) The gland from the left posterior triangle removed for diagnosis.

*Gross Examination.*—Two oval masses, the larger measuring  $3\frac{1}{2} \times 2\frac{1}{2} \times 2$  cm. the smaller  $1 \times \frac{1}{2} \times \frac{1}{2}$  cm. The larger is covered by a capsule which in places is smooth and glistening and in places rough with fibrous tissue attachments. There are many large blood-vessels on the surface. It is firm and elastic. On section the surface is finely granular, pinkish-yellow in color and somewhat spongy. There are a number of small, dark areas. The smaller resembles a simple lymph-gland with a soft, pearly-gray cut surface.

*Microscopic Examination* (Fig. 3).—On one margin there is a semilunar area of lymphoid tissue. This is separated by a thin connective-tissue layer from the

Post-operative pneumonia in left lower lobe. Pneumococcus type IV recovered.

Right lower lobe also involved. Patient very ill.

Gradual and progressive improvement. Small superficial infection in the centre of the wound, cleared up slowly, and finally discharged a silk suture.

Another gland removed from right posterior triangle for mitochondrial stain.

X-ray treatment, Dr. P. C. Hodges. Six three-inch areas marked out over sides and anterior surface of the neck. Each were given eight minutes' exposure through 3 mm. aluminium filter-tube at 10 inches with 5 milliamperes and something over 100 kilovolts.

Patient returned home seventy miles into country.

Follow-up Notes: The patient has not been able to

rest of the tissue, which is made up of epithelial cell masses arranged in small lobules and separated from one another by a delicate connective-tissue stroma. The circumference of the section shows a thin connective-tissue capsule with here and there small areas of lymphocytes. The lobules vary in size from 0.1 mm. to 1.0 mm. and are frequently partially confluent. The stroma contains many thin-walled blood-vessels, some of which are distended with blood. The epithelial masses vary greatly in character. In places the cells are in solid spheroidal or polygonal masses without glandular formation. The cells seem to be in a sort of syncytium. The ectoplasm is not distinct. The nuclei are close together and surrounded by a pale staining protoplasm. The nuclei are of a fairly uniform size, perhaps twice as large as normal thyroid cells, but not excessively large. The nuclear outlines are distinct, but the nuclei contain very little chromatin material. Occasionally small, irregular, dark-staining nuclei are seen, but no definite mitotic figures are found after prolonged search. In other places the cells are arranged in small circlets forming tiny vesicles. Many of these are empty, but in some areas many are filled with colloid material. Some also are filled with deposits of calcium, which are usually round,

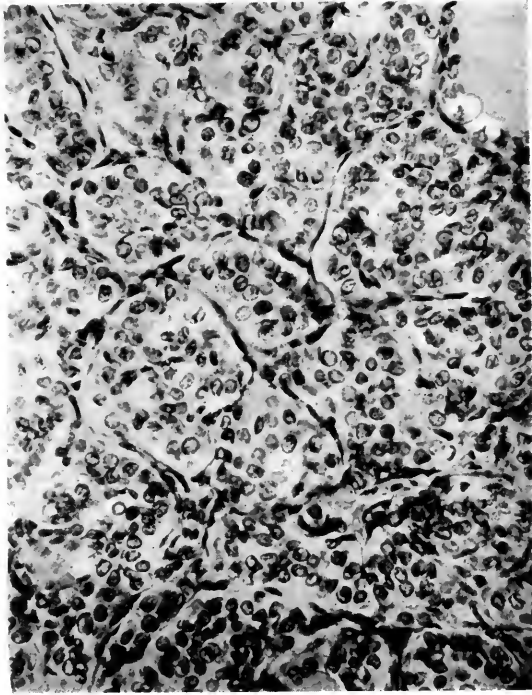


FIG. 4 (b).—Photomicrograph  $\times 260$  from the same tissue, showing cellular detail of the solid portion.

conforming to the shape of the vesicles, but in some places the calcium is irregular in shape and is contained in the surrounding cells. The cells which form the vesicles are quite similar to the cells in the solid masses described above, except that they are perhaps a trifle smaller. The ectoplasm, however, is indistinct and the syncytial appearance is the same. In still other areas there are large spaces filled up with cut branches of papillary processes which are lined either by a single or a double layer of cells. These in general are more columnar, the cell outlines are more definite, the nuclei take a position near the free margin of the cells, and photoplasmic processes reach out into the spaces surrounding the papillæ. There is no orderly arrangement of these various forms and nothing to indicate that they are stages of a single development. In some places the solid form, and in others the papillary or acinar forms, are found on the periphery.

(B) The specimens removed at the main operation (Fig. 2).

*Gross Examination.*—The character of the various specimens is identical and all resemble the original specimen described above, except that there is more attached fibrous tissue and here and there are strands of muscle.

*Microscopic Examination.*—1. The section from the substance of the sterno-

thyroid muscle (Fig. 4) shows cells of exactly the same character as those described above. The vesicular formation, however, predominates and most of the vesicles contain colloid. At one side, solid cell masses and cells in papillary formation have invaded the muscle. Some degenerated muscle fibres are seen in among the epithelial cells. Near one border there are streaks of calcium deposit.

2. The section from the right lobe of the thyroid (Fig. 5) shows many normal acini filled with colloid and lined with flattened cuboidal cells and dark-

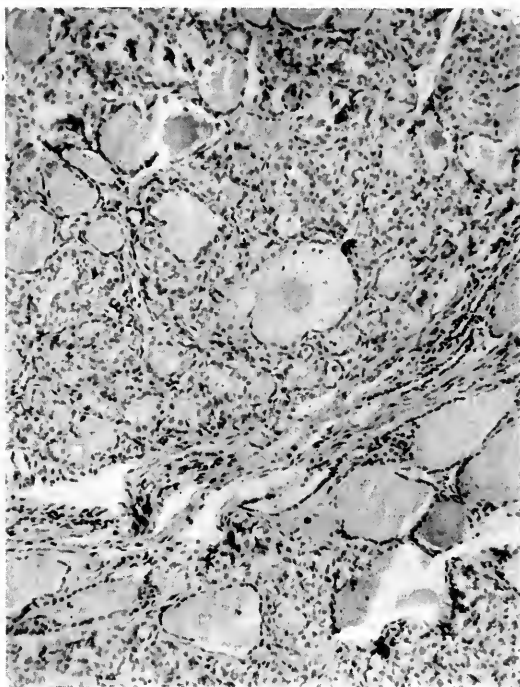


FIG. 5.—Photomicrograph  $\times 100$  from the thyroid itself, showing some relatively normal acini and some masses of tumor cells.

staining nuclei, but the inter-acinar spaces are filled with larger cells of the identical characteristics shown by the cells in the other specimens. In places these cells are grouped in large solid masses. No papillary areas are seen. A few small deposits of calcium are present.

3. The section from the lower jugular gland shows a narrow strip of lymphoid tissue at one side. Elsewhere there is a thin connective-tissue capsule over a mass of tumor tissue. Here the areas are almost entirely papillomatous. There are, however, a few solid masses, a few colloid-containing acini and many small deposits of calcium.

4. The section from the largest mass (Fig. 6) in general shows larger lobules—often 2 mm. in diameter. About half of the tissue is arranged in solid masses and the other half in papillomatous lobules with fine branching and subbranching. The spaces are filled with a pale, pink-staining substance not as dense as colloid. Occasionally blood-cells and pigment granules are seen in these spaces. There are a few colloid-filled acini and many small calcium deposits indiscriminately scattered through the tissue as well as light brown pigment. Around the margin there are remnants of lymphoid tissue. In none of the sections are mitotic figures found. The diagnosis of a malignant tumor is made upon the abnormal type of cell, the abnormal arrangement of the cells and the metastases.

*Diagnosis.*—Carcinoma of the thyroid with metastases in cervical lymph-glands.

(C) Gland removed for mitochondrial stain.

The cells differ somewhat in the number of mitochondria. In general the cells of the solid masses and the cells lining the vesicles have relatively few granules, while the cells of the papillary processes have, perhaps, twice as many. None of the cells, however, are crowded in the manner described by Goetsch<sup>5</sup> for toxic adenomata or exophthalmic goitre.



*Discussion.*—This case is interesting in several respects. The boy was seventeen and the tumor had existed for six years. One hesitates to believe that it arose first in the thyroid and metastasized into the lymph-glands six years ago, but it is even more difficult to believe that it arose in the lateral position, say in an aberrant thyroid, and metastasized into the thyroid and across the midline to the opposite side of the neck. Anatomically, as Shrager<sup>17</sup> has shown, any one of the masses could be an aberrant thyroid, but it seems unlikely that all should show practically the same pathology unless we assume that the same factor of stimulation or irritation acted upon all of them. On the other hand, the presence of lymphoid tissue on the margins of the lateral masses seems to place them definitely as lymph-gland metastases and with the thyroid involved it seems likely that the thyroid was the primary focus. The most likely explanation, therefore, for the whole picture, is a primary tumor of the thyroid arising at or before the age of eleven, metastasizing and growing for six years in the lymph-glands of the neck and mediastinum. It has frequently been recorded that the metastases of thyroid tumors may greatly exceed the parent tumor in size. In fact, thyroid tumor metastases have been reported in cases in which the thyroid seemed to be perfectly normal, although Bérard and Dunt<sup>1</sup> assert that the primary malignant focus *must* be there. The slow growth in this case is striking, particularly after metastasis had taken place, and is an evidence of relative benignancy. Some pathologists might call it benign, but the weight of opinion seems to be that any tumor which metastasizes is malignant. The absence of mitotic figures and the deposit of calcium are microscopic evidence of slow growth in this case.

How should this case be classified? It corresponds to the proliferating goitre (“wucherende struma”) of Langhans<sup>9</sup> in so far as the arrangement of cell masses and small vesicle formation is concerned. On the other hand, the papillomatous element is very prominent and Langhans<sup>9</sup> says that the

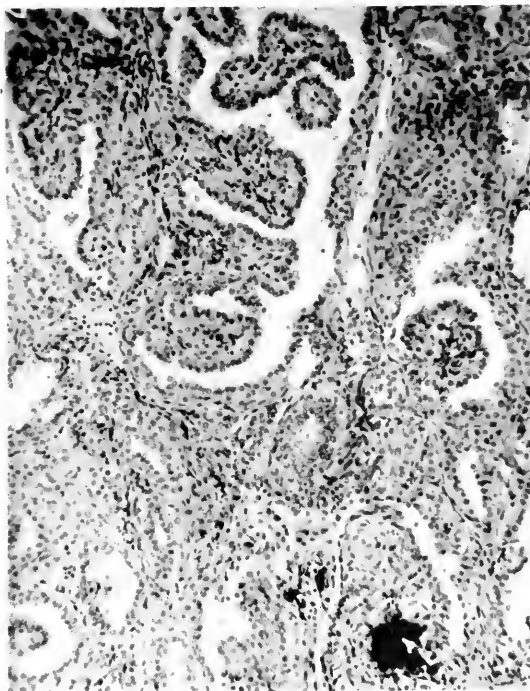


FIG. 6 (a).—Photomicrograph x 100 from the large jugular gland, showing solid masses, papillary formation and calcium deposit.

papillary form and the "wucherende struma" are very different. Furthermore, there is nothing to indicate that the various forms present are different stages of the same process as Langhans<sup>9</sup> suggests with regard to "wucherende struma," because here the various forms are indiscriminately scattered from the centre to the periphery of the specimens. Neither does it seem to fall into any of the groups into which Wilson<sup>16</sup> has classified the malignant tumors

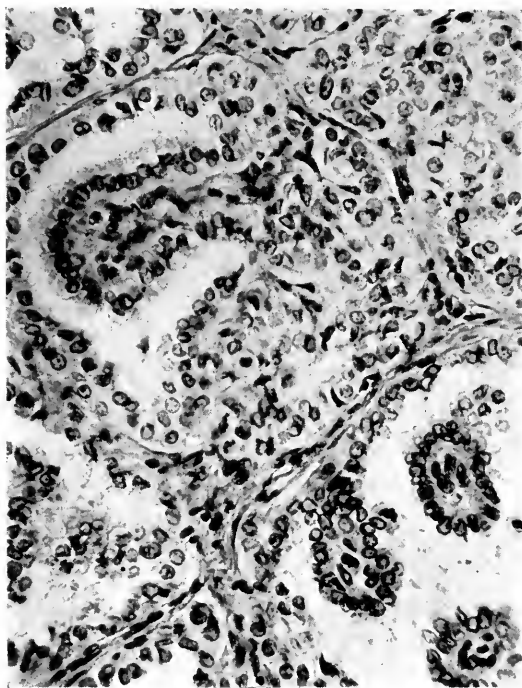


FIG. 6 (b).—Photomicrograph  $\times 260$  from the same gland, showing cellular detail.

of the thyroid. After a study of the literature on malignant thyroid tumors one is puzzled to know what the criteria of malignancy of such tumors are. It would seem that the ordinary criteria of malignancy must be changed somewhat when applied to the thyroid.

I believe that most pathologists would say that the general criteria of malignancy are (1) growth out of bounds, *i.e.*, either invasion of neighboring structures, or lymphatic or blood-vessel migration and metastasis; (2) abnormality of cell structure with the appearance of either primitive cells or cellular monstrosities; (3) reproductive activity as evidenced by the appearance of mitoses.

What are the bounds of thyroid cells? Bloodgood,<sup>2</sup> Goetsch,<sup>6</sup> and others have called attention to the fact that in the normal thyroid there are two types of cells—those forming the acini, which have a more or less definite basement membrane, and certain interstitial epithelial cells lying loosely between the acini. These latter seem to have no definite boundaries, and some observers have said that their proximity to blood-vessels makes it relatively easy for such cells to get into the blood-stream and start up metastases of normal thyroid tissue. These cells are present in still larger numbers in the adenomata and especially in the fetal adenomata. Therefore, in the examination of these specimens, it is difficult to say whether the cells are growing "out of bounds" or not. Some pathologists would even demand other proof than metastasis, *i.e.*, some changes in the cells themselves, before calling them malignant.

In other tumors the presence of undifferentiated or primitive cells is considered to be an evidence of malignancy, but primitive (fetal) cells are present in the normal thyroid and present in large numbers in the benign adenomata. Do these cells, in adult life, ever develop into normal thyroid follicles by the process described by Bloodgood<sup>2</sup> for the development of the fetal thyroid? Is this process going on all of the time as the body requires more thyroid secretion during adolescence or in the ordinary "turnover" of cells to replace those lost during the ordinary wear and tear of cellular activity? We have not seen this question answered, but it seems logical. If there is any perversion of this growth we have the "wucherende struma" of Langhans<sup>9</sup> which he says "resembles the normal organ undergoing development." May not a perversion of the development of similar fetal cells in other glands be the origin of malignant tumors elsewhere, rather than the sudden stimulation of embryonal cell "rests" or a "reversion" of adult epithelium? Such primitive cells are certainly present in the mammary gland and probably also in the testes, ovaries and uterus. Their demonstration in other glands like the stomach or colon is more difficult. Should any of these primitive fetal thyroid cells be called abnormal until they have shown definite perversion in their development? Again we must ask what are the criteria of perversity? This is a question as yet unanswered. It is in this relatively wide zone that the young pathologist is lost and even experienced pathologists disagree with regard to thyroid tumors. These disagreements make Cohnheim<sup>4</sup> and others believe that normal thyroid or benign thyroid tumors may metastasize, and Bérard and Danet,<sup>1</sup> von Eiselsberg,<sup>15</sup> and others denounce such theories as worse than heretical. These disagreements make Bloodgood<sup>2</sup> and others say that one rarely finds a history of preceding tumor growth in malignant thyroid tumors, while Wilson,<sup>16</sup> Plummer,<sup>12</sup> Speese and Brown,<sup>14</sup> and others say that they find it in nearly every case. These disagreements make Bloodgood<sup>2</sup> generally find clinically benign tumors pathologically benign, and Wilson<sup>16</sup> find clinically benign tumors frequently pathologically malignant. These disagreements make Wilson<sup>17</sup> and others say that they believe that practically all malignant tumors arise from fetal adenoma, and Speese and Brown<sup>14</sup> and others claim that other forms of benign tumors are more often antecedent. The problem now seems to be to narrow this zone of disagreement down so that the pathological cell will be more easily distinguished, so that more correct diagnoses can be made and so that more accurate prognoses can be presented to the patient. Even the criterion of cellular reproductive activity is not quite so simple as in other tumors, because the slow growth of some thyroid tumors makes mitotic figures very hard to find while, on the other hand, mitotic figures are frequently found in benign proliferations such as in the hyperplasia of exophthalmic goitre.

This all goes to show that at present the diagnosis of malignant tumors of the thyroid is very difficult, and until more data are supplied the criteria

of malignancy will be very hard to define. Until that time, the most accurate diagnoses will be made by the pathologist of greatest experience who has been able to check up his pathological observations by exact clinical follow-up data.

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# SUPPURATIVE OSTEOMYELITIS DUE TO THE COLON BACILLUS

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As recently as 1893, Déhu, *Thèse Paris*, p. 91, states that the *B. coli communis* had never been seen in bone abscess. Cushing, writing seven years later in the *Johns Hopkins Hospital Bulletin*, 1900, vol. xi, p. 160, says a colon infection only occasionally passes beyond the confines of the abdominal cavity. Judged by the number of case reports, six only, suppurative osteomyelitis of colon bacillus origin is indeed uncommon. A case of this kind having come under our observation, an account of the essential features should not be without interest.

The patient, a white male, aged fifty-two, farmer, married, entered the University Hospital, Baltimore, March 15, 1922, in the service of Dr. Compton Riely, on account of a swelling in the lower end of the right thigh which had rendered him a bedridden cripple. He was unaware of ever having injured the limb, and could assign no reason for its appearance. He had had typhoid twenty years previously and in 1918 a mild attack of influenza, from both of which he had recovered without complications. With these exceptions he had always enjoyed excellent health. On October 15, 1921, he was seized without warning with severe pains in the thigh at the site indicated. A close inspection of the place of soreness led to the discovery of a small lump. From the very onset the agony was so intense as to compel the patient to go to bed. Shortly after the beginning of the attack the skin took on a purplish hue and during the latter part of December broke, discharging a large amount of pus. Manipulation of the leg was objected to on account of the excruciating pain excited thereby. After a few weeks bed-sores developed, first on the left heel, then in rapid succession on the outer side of the right hip and over the sacrum. On admission the lower part of the right thigh was found to be very much swollen, and fluctuated behind. On March 18, 1922, under one-half per cent. procaine infiltration, a free incision was made in the back of the thigh, at the junction of the middle and lower thirds, by Doctor Riely, and a large quantity of thick, yellowish pus with the characteristic stench of the colon infection evacuated. On March 29th, a small sinus opened on the inner side of the thigh, the track of which was found to communicate with the pocket opened March 18th. Through-and-through drainage was now instituted and the abscess cavity irrigated daily with a 2½ per cent. formalin solution followed by a copious normal salt washing. By April 18, 1922, the leg was pus free and the patient's health decidedly improved. The wound had completely healed by August 10th, but the decubitus over the sacrum had not entirely cicatrized. The temperature which had been as high as 102 degrees F. was normal; the pulse had dropped from 120 to 80 and the respirations had descended from 30 to 20. A white blood-cell count made shortly after admission was 12,000; the red cells were 3,400,000. The differential picture was polymorphonuclears 62 per cent., small mononuclears 35 per cent., large mononuclears 3 per cent. The hæmoglobin was 65 per cent. The non-protein nitrogen was estimated as 27 mg. per 100 c.c. of blood; the urea 14 mg.; and the blood sugar as 90 mg.

Bacteriological studies of the pus obtained from the abscess opened March 18, 1922, showed exclusively the colon bacillus. In so far as the attack of typhoid preceded the bone lesion by twenty years, and there had never been the least intimation of its presence from convalescence till the date of the initiation of the present illness, the probability is the bone disease arose entirely independent of the earlier infection. Force is lent this conclusion by the patient's serum failing to agglutinate the typhoid or either paratyphoid group, but it did clump the organisms grown from the pus collected from the thigh in the dilution of 1 to 100, quite promptly. Though no animal inoculations were made, the organism had all of the cultural and morphological characteristics of the *B. coli*.

This case is presented as an example of an osteomyelitis from an organism which has been but seldom isolated either in pure or mixed culture from the pus of bone abscess. Whether the bone infection had any connection with the attack of typhoid or not, the association of the colon bacillus with an osteomyelitis is of clinical interest.

Berg (*Nord. Med. Archiv.*, 1895, n.s., vol. v, p. 44, translated for this paper by C. R. Ahroon, University of Maryland) reports a very similar case. The patient, a male, aged twenty-seven, had noticed for about a month in the third right costal cartilage near the edge of the sternum a nut-sized swelling of acute tenderness and adherent to the bone for which no cause could be assigned. As it was increasing in size, the man sought medical advice. On admission, September 3, 1895, there was an oval, hard, elastic tumor with a soft centre, located in the region of the right third costal cartilage. The overlying skin was normal; no lymph-glands were palpable; no demonstrable changes in the inner organs; no fever. No diagnosis was made. Exploratory incision developed a small cavity beneath the pectoral muscle filled with a thin pus, in the bottom of which lay a diseased costal cartilage. The entire cartilage was excised and the wound closed loosely. Healing took place promptly. Microscopical examination for the tubercle bacillus was negative. Guinea-pigs, inoculated intraperitoneally with some of the pus as well as subcutaneously, died in fourteen days. Sections from these animals showed no tubercle organisms; but fluid from the peritoneum, spleen, liver and heart contained the same bacterium as that of the pus implanted in agar. At the site of the subcutaneous injections, abscesses, filled with thick pus, formed. No tubercle bacilli were found in this exudate. Cultures made at the time of the operation in agar showed the *B. coli communis* alone.

The next case is recorded by Blumer (*The Pacific Record of Medicine and Surgery*, 1898, vol. xiii, p. 105). The patient, a woman, aged forty-five, in April, 1897, passed through a "typhoid" attack of moderate severity. The disease ran a course of twenty-eight days. In the fourth week of the illness the patient began to complain of pain at the point of junction of the fourth rib with the sternum, where a small, deep-seated nodule soon appeared. There was no redness of the overlying skin; no oedema. A collection of pus was suspected, so the area was aspirated but without result. The patient returned home and was not seen again until October 12, 1897, when she was readmitted for a lump in the left chest which had been of a gradual development. The mass was removed whole, but the wound never healed, a sinus persisting which discharged a thin sero-pus. At a second operation in January, 1898, the rib was found necrosed at its point of union with its cartilage. The diseased bone was removed and the wound packed. Then healing was rapid and the patient has since enjoyed good health. The *B. coli* was the only organism isolated from the pus. In this case Cushing thought the evidence adduced hardly justified the claim in that the organism

recovered was an alkali producer. He was more inclined to regard its proper place as intermediate between the typhoid and colon groups.

Martina (*Arch. f. klin. Chir.*, 1907, vol. lxxxiii, p. 906) also cites a case of costal chondritis due to a colon bacillus infection. The patient, a man, aged forty-seven, was attacked September 15, 1905, with a moderately severe fever of four weeks' duration which was diagnosed typhoid. Six weeks after the onset of the malady the patient noticed in the region of the right third costal cartilage a small mass which by November 23, 1905, had attained the size of an orange. It was not accompanied by fever and caused pain only when the body was jarred. He was admitted to the hospital, November 23, 1905, for a deep-seated swelling which fluctuated. It was aspirated with the recovery of a thin purulent liquid which was immediately inoculated into various culture media. On November 24th, under local anæsthesia, Payr made a free incision into the abscess and emptied it of its contents. Although the cartilage was well exposed, no damage was detected to its perichondrium. Under the assumption the abscess was of the soft parts exclusively, a few sutures were placed at the angles of the wound and the cavity packed with gauze. Three weeks later the wound had contracted down to a small channel which secreted occasionally a few drops of pus. Notwithstanding the employment of various measures, the sinus remained refractory and declined to heal. Therefore three months after the first operation, the man was induced to submit to a second intervention. On this occasion, February 20, 1906, under general anæsthesia, the fistula was slit down to the cartilage which was exposed in its entire length. As the cartilage was now extensively necrosed, it was completely removed. The wound was solidly united in four weeks. From the pus obtained at aspiration the colon bacillus was isolated in pure culture.

The latest to report the recovery of the bacterium coli in pure culture from the pus of a bone abscess is Satta (*La Chirurgia degli Organi di Movimento*, 1922, vol. vi, p. 105). His patient, a man, aged thirty, was wounded in the left leg, September 15, 1916, with a piece of shell. At the same time the tibia suffered a comminuted fracture which became rapidly infected. Not until February 25, 1917, after five months of constant care, was the limb pronounced well. According to the patient's statement the discharge had been unbearably offensive. He had never been operated upon. On April 25, 1917, the temperature ascended and he was suddenly seized with intense pain at the seat of the fracture. As the agony did not subside, he was promptly returned to the hospital, the edges of a scar located on the antero-internal aspect of the upper third of the left leg, were red and brawny. The involved area was exquisitely tender on pressure. X-ray examination revealed an osteomyelitis without a visible foreign body. Hence on May 14, 1917, an incision was made down to the tibia. The periosteum when slit gave exit to a collection of thick, yellowish, stinking pus mixed with gas. At a spot in the cortex of the bone was a greenish scab which marked a point of softening and purulent infiltration. While reaming away this débris the curette slipped into a medullary pocket full of the same kind of pus. Though the bone was widely opened and drained, the temperature continued high and the boggiess extended into the neighboring tissues, necessitating on May 17th a new incision, which released a subaponeurotic and intramuscular collection of similar character. Notwithstanding the wound was now energetically Dakinized, no improvement followed; consequently a low thigh guillotine amputation was done May 28, 1917. As there was still no abatement in the temperature and the stump continued to secrete an abundance of evil-smelling matter, an autogenous vaccine was prepared and injected daily in progressively increasing dosage. On June 7th, an abscess formed in the left gluteal region which crepitated on palpation. This when lanced contained a pus identical in all respects to that collected from the medulla. Not until June 9, 1917, did the

patient begin to show any improvement. Shortly thereafter the femur extruded a sequestrum and the wound had cicatrized sufficiently for the man to be discharged July 28, 1917. From the morphological characteristics and the cultural picture the bacterium isolated from the tibial abscess was certified as the colon bacillus. The serum of the patient did not agglutinate this organism. Blood cultures were apparently neglected. Whether the microbe was carried into the wound and had lain dormant for five months, or whether it was transported there by the blood-stream at a later date, is impossible of proof. In either event the fracture must have afforded a favorable pabulum for its propagation.

In the two following cases the colon bacillus was found mixed with the bacillus of Eberth.

Klemm (*Arch. f. klin. Chir.*, 1894, vol. xlviii, p. 793) reports the case of a girl, aged sixteen, who showed near the close of a severe and typical typhoid fever, a sudden increase in the severity of the symptoms with the appearance of a marked swelling at the middle of one thigh. She had been sick eight days when she entered the hospital, October 24, 1893. It was not until November 8th, that the fever broke in the morning, but there was always a slight evening rise. December 7th, an abscess formed in the neighborhood of the right great trochanter. This was promptly incised. On December 13th this incision had to be extended. The thigh was then held in constant flexion at the hip-joint. In order to prevent a permanent contracture, the limb was put up in extension, but the patient complained so bitterly of the arrangement that the apparatus had to be removed December 18th. The same day the patient had many chills and the temperature ascended. December 21st, a puffiness was noticed at the middle of the left thigh. The affected area was exquisitely tender and the overlying skin was intensely injected. The girl by that time was in a state of collapse. On December 23, 1893, this swelling not only fluctuated, but was accompanied by a crepitation, and the emphysematous area on percussion gave a tympanitic note. An aspiratory puncture was rewarded with the recovery of a few drops of pus, and from the path made by the needle a stinking hissing gas escaped. On December 25th, a spontaneous fistulization occurred, from the mouth of which poured a quantity of brownish-red, ill-smelling matter. The patient died December 28, 1893, in collapse. Both the typhoid and colon bacillus were isolated from the pus obtained by aspiratory puncture, December 23, 1893. At autopsy the left femur was devoid of periosteum and the cortex was necrotic, but no pus was seen in the central canal.

Arcoleo (*Il Morgagni; Giorn. Indir. al. Prog. della Med.*, Milan, 1899, vol. xli, p. 653) reports the other case of mixed typhoid and colon bone infection. The patient, a woman, aged twenty-one, was taken ill of typhoid on May 2, 1898. The disease ran a course of six weeks. During convalescence she noticed a tumefaction in the great trochanter of the right hip and ten days later a swelling at the middle of the anterior surface of the left thigh. The skin was red, tender to pressure, and the mass fluctuated. There was a sense of crepitation on palpation of the soft tissues and a tympanitic note was present. The right thigh was incised, but the left only aspirated for the purpose of obtaining some pus for bacteriological study. With the withdrawal of the syringe a few bubbles of fetid gas escaped. Next morning the abscess opened spontaneously, giving exit to a large quantity of brownish-red pus. The patient died in collapse the same day. At autopsy nothing of interest was found except an osteomyelitis of the left thigh.

Other instances of bone inflammation, with the colon bacillus playing the etiological rôle, may be on record, if so, I have no knowledge of them. It is true that Klemm (*Beitr. z. klin. Chir.*, 1913, vol. lxxxiv, p. 408) says of 320



osteomyelites, 280 were examined bacteriologically, with the isolation of the colon bacillus once, but other than tabulating the case as occurring on pp. 378 and 402, no information is forthcoming. This is obviously the case reported by Klemm in *Arch. f. klin. Chir.*, 1912, vol. xcix, p. 455. The patient, aged nine months, was brought to the hospital for an increasing and fluctuating swelling of the right shoulder of two weeks' duration. Lancing of the abscess served a twofold purpose—the release of much purulent matter from the joint and the disclosure of a pus pocket in the head of the humerus. Erasion of the débris effected a cure. Although the colon bacillus was found in the pus, the case has been omitted as an example of this type of osteomyelitis, as the main force of the inflammation was directed against the joint.

The condition is of interest mostly from the fact that under circumstances of which we are ignorant, this organism, either alone or in association with other germs, can cause bone suppuration. Four of these patients were men; three, women. The age seemed to have played no part in the incidence, viz., sixteen, twenty-one, twenty-seven, thirty, forty-five, forty-seven, and fifty-two years, respectively. The bones involved were: femur three times; costal cartilages thrice; tibia once. The two cases with mixed infection died. The patient in whom the organism was recovered from the tibia recovered only after an amputation through the thigh. The three instances of costal chondritis all recovered after complete extirpation of the cartilage involved. The man suffering with the infection at the lower end of the femur has been cured of the osteomyelitis, but is still confined to the hospital on account of a cicatrizing sacral decubitus.

In those cases in which the colon bacillus was recovered in pure culture but a single bone was involved whilst in the instances of mixed infection both femurs were diseased. In one case no diagnosis was made; in one the bone lesion followed a gunshot fracture of the tibia; whilst in the remaining five the patient had had typhoid-like attacks. The time of the appearance of the lesion was: Initial lesion, 1; fourth week of illness, 1; near the close of a typical typhoid, 1; six weeks after onset of typhoid, 2; five months after the receipt of injury, 1; twenty years after the attack of typhoid, 1.

Too few cases have been published to offer any definite conclusions. It would appear from the cases reported that this type of osteomyelitis may occasionally undergo spontaneous resolution; that it may occur in either an acute or chronic form; that it has periods of quiescence and activity; that a most thorough eradication of the diseased bone is sometimes necessary to effect a permanent cure; that vaccine treatment may prove a valuable adjuvant in stubborn cases. The prognosis is relatively favorable, as regards life, only two cases of this series dying, both of which were mixed infections and of a very acute type. Unfortunately blood cultures were made in none. I am inclined to believe this type of osteomyelitis would be encountered more frequently were bacteriological studies made in all cases of bone abscess.

# THE TREATMENT OF CHRONIC EMPYEMA WHERE THE RECOGNIZED SURGICAL PROCEDURES HAVE FAILED TO PRODUCE OBLITERATION

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*Continued from page 580*

CASE IX.—H. T., age twenty-four years, developed influenza followed by lobar pneumonia, January 22, 1919, and the latter complicated by empyema, right

pleural cavity, January 26, 1919, hæmolytic streptococcus type. Later developed otitis media, acute, catarrhal, right.

Patient had four operations prior to admission to Empyema Service with resection of the fourth to tenth ribs inclusive.

Admitted to Empyema Service, November 26, 1920.

Condition on admission: Ambulatory, general condition good; normal weight 140 pounds; present weight 127 pounds.

Examination of chest reveals sinus discharging pus, tenth interspace. Ra-

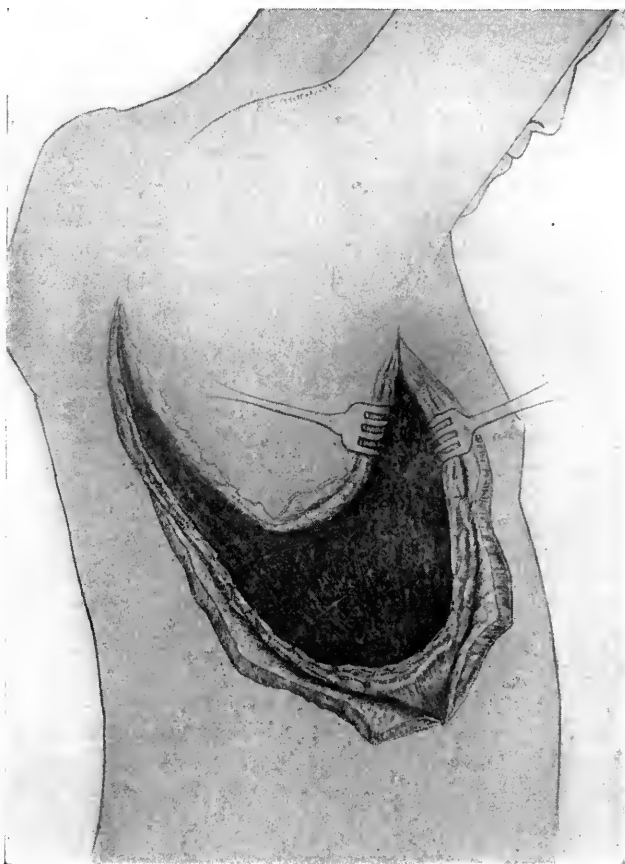


FIG. 25.—Case IX. First step of fractional operation.

diograph shows marked collapse of right chest wall with elongated bismuth-filled cavity, approximately 16 cm. in length, and 2.5 cm. at its widest portion in the lateral portion of the chest just under the soft tissue covering. This cavity runs from the tenth interspace to the fifth interspace, axillary line. There has been a resection of the fourth to tenth ribs, right side. Cavity shows smooth outlines with no evidence of diverticulæ or bronchial fistulæ.

## TREATMENT OF CHRONIC EMPYEMA

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; urine negative; red blood-cells, 4,880,000; white blood-cells, 8800; hæmoglobin, 85 per cent. Blood-pressure: systolic, 120; diastolic, 80; pulse-pressure, 40; vital capacity reading not taken. Culture from cavity showed hæmolytic streptococci and staphylococci aureus.

*Surgical Treatment, Fractional Procedure.*—December 2, 1920. The first step of the fractional type operation was accomplished. The upper angle of the wound was attacked, ribs resected, and the old cavity laid widely open at this point. A portion of the serratus magnus, the rhomboideus major and subscapularis muscles implanted immediately into the cavity and sutured into place (Fig. 25).

The muscle bodies held and there was practically no sloughing following this operation.

January 17, 1921. An incision at the lower angle of the old wound was made, the scar tissue was excised and multiple sinuses were found leading in all directions. Sinuses curetted and the wound left open.

Patient placed on active Dakinization. His condition seemed to be improving somewhat and it was decided to refrain from further operative procedure until there was a more definite improvement in the general condition. Capacity of cavity at this time, 200 c.c.

April 5, 1921. Resection of third to eighth ribs over anterior and lateral chest wall; cavity laid wide open. The apex of cavity was found to be obliterated following the muscle implantation at previous operation.

July 6, 1921. Patient has obliterated his cavity rapidly, but there is evidence of osteomyelitis of the terminal seventh, eighth and ninth rib stumps. Necrotic rib stumps resected.

July 27, 1921. A sliding skin flap with its subcutaneous fat twisted on its

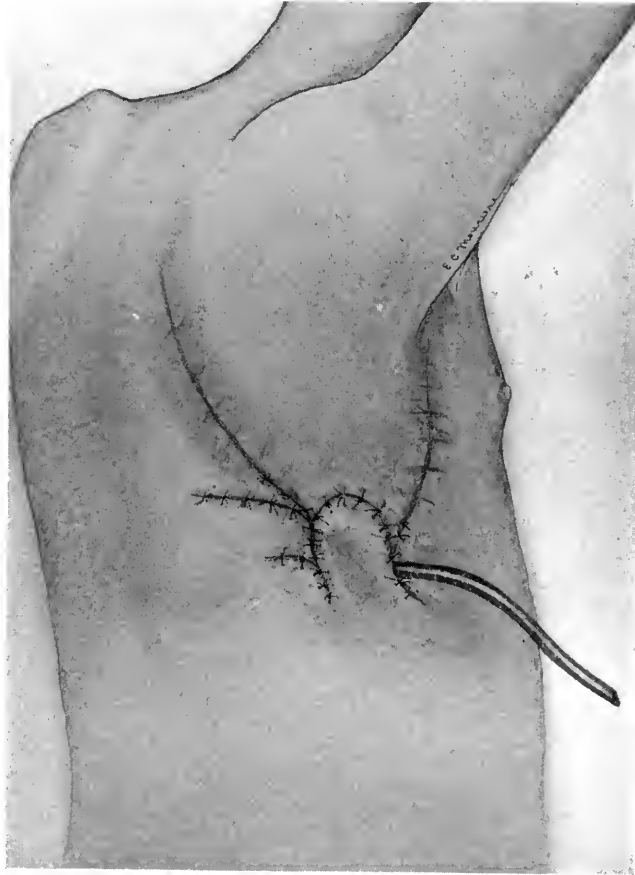


FIG. 26.—Case IX. Result after fifth step.

pedicle and transplanted into the lower angle of the wound, entirely closing this part of the cavity. A small part of the cavity remaining above this point can be obliterated by lung expansion on forced inspiration of the patient (Fig. 26).

September 19, 1921. Sinus tract allowed to close as patient has had seven consecutive daily sterile cultures.

November 1, 1921. Patient entirely healed.

December 6, 1921. Patient given thirty-day leave.

January 6, 1922. Returned from leave feeling fine, entirely healed; ready for discharge from hospital.



FIG. 27.—Case IX. Final result.

January 31, 1922. Patient discharged from hospital cured this date. X-ray taken prior to discharge showed rather marked collapse of chest wall, especially at the base, but no evidence of cavity (Fig. 27).

Factors to be combated in this case are:

1. Hemolytic streptococci and staphylococci aureus present.

2. Osteomyelitis of terminal rib stumps.

CASE XI.—  
R. C. W., age thirty years, received gunshot wound, multiple wounds, right

chest and right leg, October 6, 1918, in action. Developed broncho-pneumonia, traumatic complicated by empyema, October 17, 1918. Aspirated twice.

November 1, 1918. Thoracotomy with resection  $1\frac{1}{2}$  inches, tenth rib, right. Lower wound allowed to close, but pus continued to drain through upper gunshot wound of chest.

December 8, 1918. Operation.—Thoracotomy with resection of part of eighth rib, right. Dakinization attempted but not carried out, on account of pleuro-bronchial fistula.

April 8, 1919. Operation.—Resection of part of seventh rib, right, mid-axillary line. Tube drainage.

## TREATMENT OF CHRONIC EMPYEMA

July 5, 1919. Resection of fifth, sixth and seventh ribs, mid-axillary line, right. Dakinization of wound followed.

Drainage of wound continued; various antiseptic solutions being used, including gentian violet and bismuth paste. The cavity remained unobliterated and he continued to drain pus.

Admitted to Empyema Service, January 20, 1921.

Condition on admission: General condition good; has gained markedly in weight since original injury. Examination of chest shows a sinus at level of the

eighth rib, posterior axillary line, right chest. Sinus too small to admit tube drainage. Profuse discharge of thick pus on dressing.

Radiograph shows a partial resection of parts of the fifth, sixth and seventh ribs, anterior axillary line, with resection of part of the ninth rib. There has been proliferation of the rib ends with union and cross-union of previously resected ribs. Cavity runs posteriorly along the diaphragm, then upward to sixth rib posteriorly. Cavity lies about the scapular line and about 6 cm. from the mid-line of spine. Thickened pleura over entire right chest. Capacity of cavity about 500 c.c.



FIG. 28.—Case XI. Showing result of muscle implantation.

Thickened pleura over entire right chest. Capacity of cavity about 500 c.c.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; urine negative; culture from cavity showed gram-positive bacilli; non-hæmolytic; staphylococcus aureus present. Blood-pressure: systolic, 130; diastolic, 84; vital capacity, 2400 c.c.

*Surgical Treatment, Fractional Procedure.*—February 2, 1921. Incision along old sinus tract; resection of sixth, seventh and eighth ribs over cavity; exposure of entire cavity with removal of parietal pleura and intercostal tissues. Excision of the sinus tract; dissection of the visceral pleura. The cavity and wound

were packed with gauze and Carrel tubes and active dakinization of the cavity started.

The extent of cavitation can be judged by the fact that at the daily dressings some forty-two Carrel tubes were laid in the cavity between the layers of gauze.

The cavity became clinically and bacteriologically clean within a short time. The capacity of the cavity diminished with remarkable rapidity. At the time of the first plastic operation April 1st, the cavity had obliterated about fifty per cent.

Frequent scarifications of the visceral pleura were made and this apparently

hastened the obliterative process by permitting reexpansion of the underlying lung.

April 1, 1921. Removal of sequestrum of eighth rib. The cavity being sterile, a plastic closure of the upper angle of the cavity was done. Contiguous muscle bodies at the lateral margin of the wound were partially split and swung into the cavity and sutured *in situ* to the visceral pleura and sides of the wound. Following this implantation, there was slight superficial necrosis of the muscle implant,

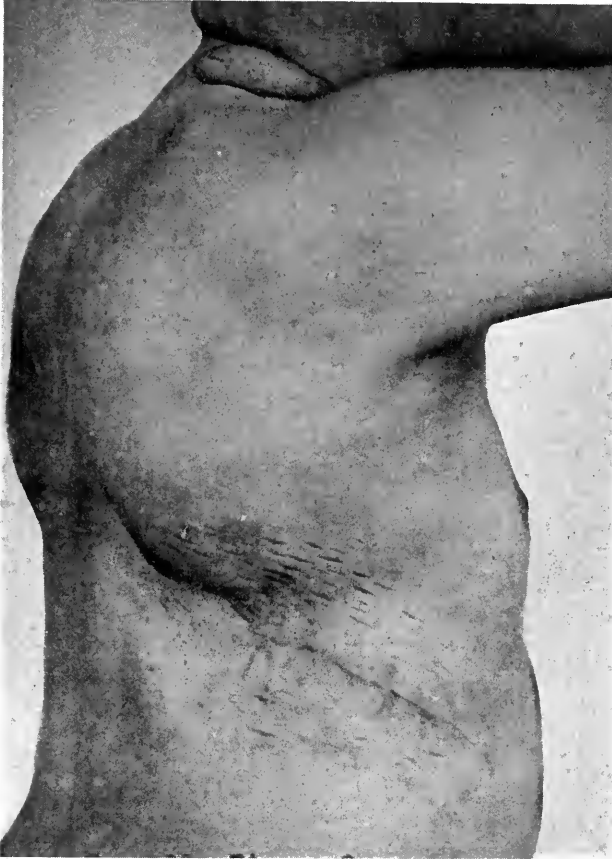


FIG. 29.—Case XI. Final result.

but the greater part of it became adherent and obliterated to a great extent the upper half of the wound and cavity (Fig. 28).

June 3, 1921. Plastic closure of remaining cavity in its lower half. The upper half was now completely obliterated from the previous plastic operation. Plastic closure was done as in the upper half by the implantation of a large muscle plane. Skin and superficial tissues were brought into apposition and the wound closed with rubber tissue drainage.

The wound healed with the exception of a small sinus, which persisted, and continued to drain a slight amount of sero-purulent exudate.

July 12, 1921. Incision along lower part of old scar laying open a branched

sinus tract. This was lined with infected granulations but no rib involvement could be found. It was curetted and left open for Dakin treatment. The old cavity was practically entirely obliterated.

September 16, 1921. Operation.—Final plastic to restore contour of chest wall. Small gutter depression along lower part of old cavity closed by suture of opposing muscle bodies and skin.

Recovery uneventful; wound healed two weeks following last plastic operation.

Patient granted several sick leaves and kept under observation until May 11, 1922, when he was discharged cured, having been healed seven months. (Fig. 29.)

Factors to be combated in this case are:

1. Hæmolytic streptococcus, staphylococcus aureus and pyocyanus organisms present prior to admission.
2. Extremely large cavity.
3. Osteomyelitis with sequestration of rib stumps.
4. Marked lung collapse with dense adhesions and greatly thickened visceral pleura.

Terminal examination shows no cavity formation clinically or by radiograph. Fair lung expansion on the involved side. There is but slight deformity of the chest wall. General condition of patient excellent.

CASE XIII.—C. A. M., age nineteen years, developed pneumonia, January 25, 1920, complicated by empyema, right pleural cavity, hæmolytic streptococcus type. February 1, 1920. Aspirated five times.

May 5, 1920. Thoracotomy with resection of 5 cm. of eighth rib. Intermittent dakinization; drainage continued up to time of admission.

Condition on admission: General condition good; slight anæmia; weight normal, 200 pounds.

Examination of chest reveals sinus discharging pus at the level of the eighth rib, mid-axillary line, right side. X-ray examination showed sinus at the level of the eighth rib leading into a cavity about 20 cm. in depth, which extends backward and upward, following the course of the seventh, eighth and ninth ribs; capacity of cavity, 250 c.c.

Laboratory examinations: Wassermann negative; urine negative; sputum negative for tubercle bacilli; red blood-cells, 4,500,000; white blood-cells, 5200; hæmoglobin, 75 per cent.; culture from cavity shows streptococcus hæmolyticus.

*Surgical Treatment, Fractional Procedure.*—January 17, 1921. Resection of 20 cm. of the eighth, ninth and tenth ribs with excision of sinus tract leading to the spinal gutter. A second sinus tract was found leading to the posterior diaphragmatic sulcus. The original sinus and ribs surrounding it were not touched at this operation; cavity left wide open for active Dakinization (Fig. 30).

March 14, 1921. Second step of fractional operation done. Excision of sinus tract with resection of about 10 cm. of ninth rib; cavity left open for Dakinization.

Following these operations patient obliterated his cavity rapidly.

May 12, 1921. The cavity at this time was less than one-fourth its original size; a plastic closure was done; implantation of part of the serratus magnus to fill the remaining unobliterated portion and sliding skin flaps were brought forward from each side and sutured. (Fig. 31.)

June 5, 1921. Wound healed; general condition excellent.

August 11, 1921. Patient discharged, healed two months. Cured. (Fig. 32.)

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Osteomyelitis of terminal rib stumps.
3. Diverticulæ or accessory pockets.

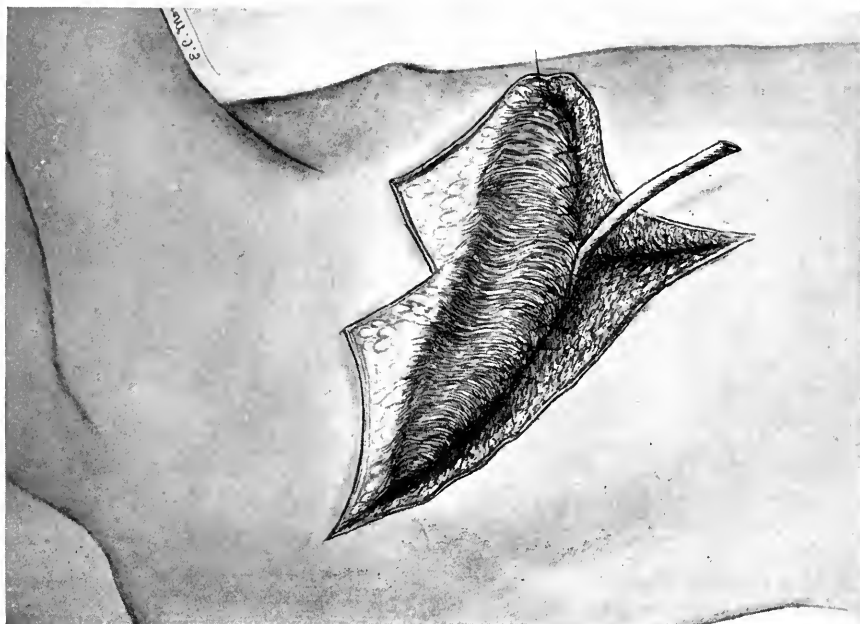


FIG. 31.—Case XIII. Result of plastic muscular implantation.

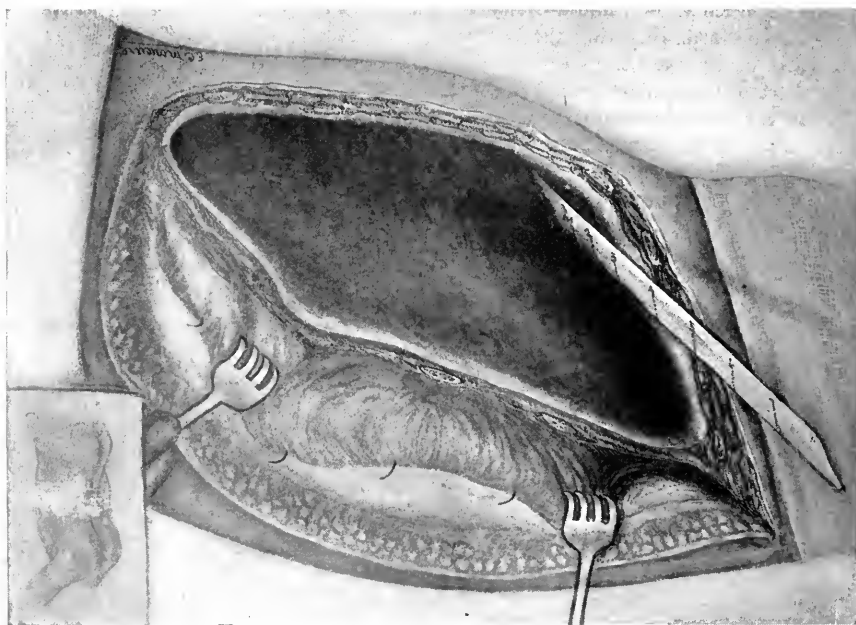


FIG. 30.—Case XIII. Showing extent of primary rib resection, and magnitude of cavity.



## TREATMENT OF CHRONIC EMPYEMA

CASE XV.—O. C., age twenty-eight years, developed influenza and pneumonia, September 15, 1918, complicated by empyema, left pleural cavity, hæmolytic streptococcus type, October 10, 1918; aspirated twice.

October 16, 1918. Operation.—Thoracotomy, resection of portion of sixth rib mid-axillary line, drainage and irrigation of cavity with Dakin's solution.

November 17, 1918. A secondary drainage operation was done, with removal of a portion of the seventh rib.

August 22, 1919. Decortication operation with resection of portions of fifth, sixth, seventh, eighth, ninth and tenth ribs and drainage of the lower aspect of the cavity.

September 17, 1920. Resection of an additional portion of eighth rib stump and the resection of 5 cm. of the third and fourth ribs, posterior scapular line, left chest.

Following this the patient would heal and break down with a persistent expectoration of blood from pleuro-pulmonary communications.

Admitted to Empyema Service, February 10, 1921.

Condition on admission: Ambulatory

case, anæmic, poorly nourished and considerably under weight; normal weight 145 pounds; present weight 127 pounds; extremely toxic with renal complications, chronic interstitial nephritis.

Examination of chest: Revealed great deformity in the contour of the left lateral chest with an "axe-chop" appearance and a sinus discharging pus mid-axillary line.

Radiographs showed marked collapse of the left lung with extensive thickening of the pleura from apex to base and a cavity formation extending from the third to the eighth rib, left lateral chest, with a capacity of 250 c.c. A pleurobronchial fistula was present and osteomyelitis of resected rib stumps noted.



FIG. 32.—Case XIII. Final result.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 13,560; red blood-cells, 3,970,000; urine showed heavy trace of albumin and hyaline and granular casts. Culture from cavity showed hæmolytic streptococcus. Blood-pressure: systolic, 144; diastolic, 86; pulse-pressure, 58; vital capacity reading, 1600 c.c.

*Surgical Treatment, Fractional Procedure.*—February 18, 1921. Operation.—Incision along line of old scar, cavity laid wide open; necrotic rib stumps removed; excision of thickened parietal pleura forming roof of cavity; discission of visceral

pleura to allow lung expansion; all skin and muscles preserved for final closure and preparation of cavity for active Dakinization.

June 9, 1921. Operation.—Partial closure with the suturing of the fistula present and the implantation of a portion of the latissimus dorsi muscle over same; upper aspect of cavity closed, muscle and skin; lower portion left open for active Dakinization. (Fig. 33.)

September 13, 1921. Incision of sinus tract leading posterior and upward communicating with

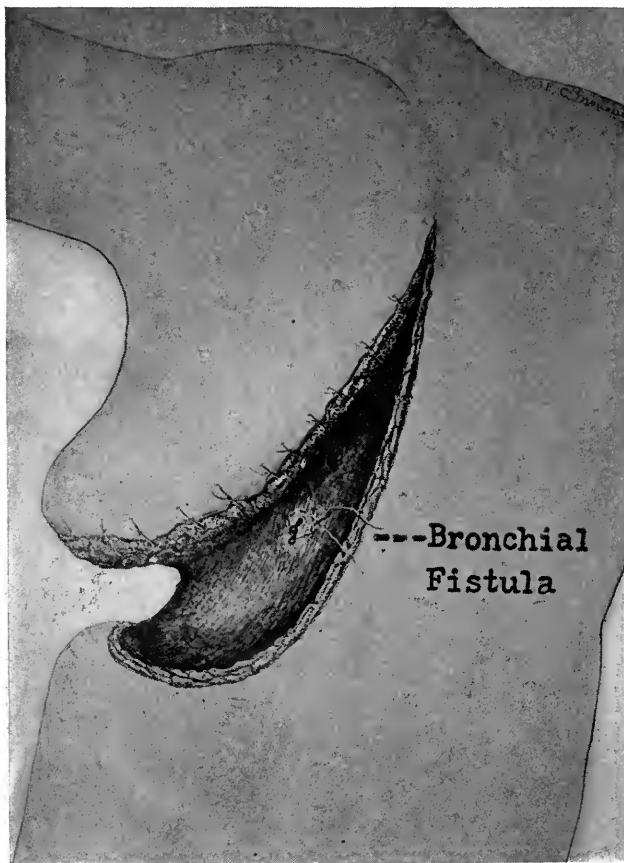


FIG. 33.—Case XV. Showing suture of bronchial fistula.

the main cavity, the same left wide open for active Dakinization.

October 1, 1921. Cavity sterile by seven consecutive daily cultures.

October 5, 1921. Resection of 5 cm. of the regenerated fifth and sixth ribs.

posterior scapular line. Discission of visceral pleura; fistula is closed. Plastic flap of the subscapularis muscle implanted in upper aspect of remaining cavity; superficial muscles brought in apposition and sutured; skin closed with figure-of-eight silkworm gut; multiple scarifications of skin to cause relaxation; lower aspect of wound left open to granulate. (Fig. 34.)

November 30, 1921. Patient entirely healed and gaining weight. X-ray

shows all cavity formation obliterated; general condition excellent; urine negative for albumin or casts. Weight on admission 127 pounds; present weight 148 pounds; vital capacity reading, 2400 c.c.

March 1, 1922. There is a small trophic ulcer in the area of the old scar which is being strapped and is gradually becoming smaller. Patient's general condition excellent; appetite good; has taken on weight and strength and will soon be ready for final disposition. (Fig. 35.) Factors to be combated are:

1. Hæmolytic streptococcus organism present.

2. Pleuro-bronchial fistula present.

3. Osteomyelitis of rib stumps.

4. Secondary cavity formation.

5. Chronic interstitial nephritis.

6. Marked collapse of left chest wall due to previous operative procedure.

April 4, 1922. Patient entirely healed and discharged from hospital cured.

CASE XVII.  
W. G., age thirty years, developed influenza and pneumonia, October 1, 1918,

complicated by empyema, right pleural cavity, hæmolytic streptococcus type, October 13, 1918. Aspirated once.

October 15, 1918. Operation.—Intercostal thoracotomy eighth interspace, posterior axillary line, with the institution of drainage.

December 23, 1918. Thoracotomy with resection of a portion of the eighth rib, posterior axillary line, and better drainage instituted.

September 24, 1919. Decortication operation with resection of a portion of fifth, sixth, seventh, eighth, ninth and tenth ribs with complete decortication of visceral pleura and wound closed with dependent drainage. Following this operation, there was a slough of the soft tissues along posterior incision and a protrusion of rib stumps into opening with exposure of nerve ending from posterior



FIG. 34.—Case XV. Showing final muscular implantation.

horn cells. Dressings very difficult at this time; Dakin solution tried but discontinued on account of bronchial fistula, which caused patient to strangle; iodoform emulsion used in dressings; mercuracrome also tried. Patient exposed to sun rays and to various forms of tub baths. Treated by these various methods until September 23, 1920.

Admitted to Empyema Service, September 24, 1920.

Condition on admission: Litter case, anæmic, highly septic, poorly nourished,



FIG. 35.—Case XV. Final result.

and considerably under weight; normal weight 140 pounds; present weight 96 pounds. General condition extremely poor. Examination of chest revealed large open wound, posterior scapular line, with retraction of soft tissues in this area, and exposed necrotic posterior rib stumps fifth, sixth and seventh, with considerable unhealthy granulations about same; posterior horn cells exposed and patient extremely sensitive over this area. This open wound communicated with his cavity

formation, which has a capacity of 650 c.c. (Fig. 36.)

Radiographs showed almost total collapse of right lung with extensive thickening of the pleura, right chest, from apex to base, and a large cavity formation extending from first to tenth rib, lateral chest. A large pleurobronchial fistula noted; marked osteomyelitis of resected rib stumps. A cold abscess was present over right sacro-iliac region.

Bacteriological examination: Wassermann negative. Sputum negative for tubercle bacilli; white blood-cells, 9750; red blood-cells, 3,750,000; urine negative. Culture from cavity showed heavy growth of hæmolytic streptococcus. Blood-pressure: systolic, 108; diastolic, 76; pulse-pressure, 32; vital capacity reading, 1300 c.c.

## TREATMENT OF CHRONIC EMPYEMA

This patient's general condition was so poor at time of admission that it was necessary to build him up before he could withstand even a fractional type of operation. This was accomplished by stomachics and a high caloric diet; egg-nogs at least three times daily. Cold abscess was injected with iodoform emulsion and strapped. Cavity given active Dakinization.

*Surgical Treatment, Fractional Procedure.*—October 29, 1920. Operation.—Resection of necrotic rib stumps, fourth, fifth and sixth and removal of unhealthy granulations, with mobilization of lung about fistula. Deep alcohol injection of nerves from posterior horn cells. Cavity left open for active Dakinization. (Fig. 37.)

February 4, 1921. Resection of 15 cm. of third, fourth, fifth and sixth ribs, anterior chest, one inch from costochondral junction; excision of thickened parietal pleura and dissection of visceral pleura to allow lung expansion. Skin inserted over severed superficial muscles and fixed. Cavity left open for the continuation of active Dakinization.

April 13, 1921. Operation.—Resection of a portion of ninth and tenth ribs, posterior axillary line, and resection of regenerated portion of sixth and seventh ribs, anterior axillary line. Dakinization continued.

June 21, 1921. Operation.—Resection of 10 cm. of second, third and fourth ribs, posterior scapular line, right chest. Excision of thickened parietal pleura and exposure of apex of cavity; mobilization of lung about fistula; Dakinization continued; all muscle and skin saved and tucked beneath scapula.

Following this operation, the angle of the scapula made pressure on underlying lung structure, hence patient was dressed with a thin steel rib two inches wide and constructed so as to fit the general contour of the chest. This band was well padded and passed beneath the angle of the scapula (Fig. 38) and was fixed in place

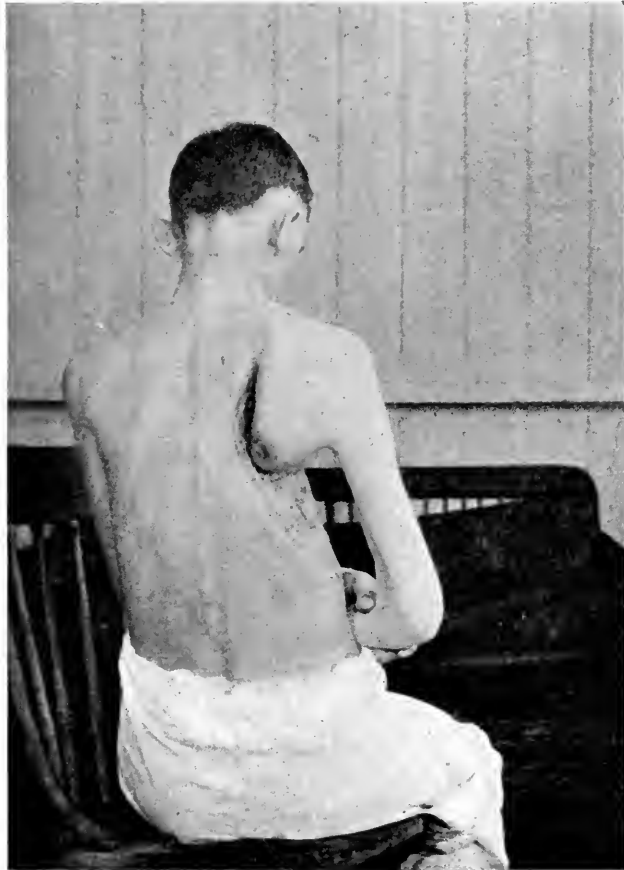


FIG. 36.—Case, XVII. Condition on admission.

by straps over the shoulders and tape across the terminal end of the steel rib on the unaffected side of chest. This held the angle of the scapula away from the underlying lung and still did not interfere with active Dakinization of the cavity.

July 19, 1921. Closure of bronchial fistula by means of mobilization of lung about same and mattress suture. Dakinization continued.

September 13, 1921. Decortication of visceral pleura about fistula that still remains patent and purse-string ligation of same. Dakinization continued.

October 1, 1921. Fistula still patent, although it is considerably smaller. A



two per cent. alcoholic solution of gentian violet applied and the following day fistula was closed. This was repeated to keep mechanical plug in same until granulations had obliterated tract.

November 15, 1921. The remaining cavity formation in this case consists of a pyramid-like shaped cavity, with its base in the upper aspect of the right chest between three bony structures: clavicle anteriorly, first rib internally and superiorly, and the scapula posteriorly, with the apex of the cavity downward and in the

FIG. 37.—Case XVII. Showing situation of bronchial fistula and extent of cavity.

mid-axillary line. It was necessary to devise some method to obliterate this space as maximum amount of lung expansion had been obtained by discission of visceral pleura.

December 1, 1921. Shortening of clavicle to obliterate aforesaid space. Clavicle shortened two inches and fragments mortised and wired in apposition; muscle and skin closed over same. (Fig. 39.)

December 28, 1921. Operation.—Resection of regenerated third and fourth ribs, anterior axillary line, to allow scapula free excursion of motion since clavicle has been shortened and to completely obliterate the space. A portion of the pectoralis major and subscapularis muscles were implanted into apex of space

## TREATMENT OF CHRONIC EMPYEMA

to act as a buffer between the scapula and the underlying lung structures.

Following these operations the angle of scapula was reflected backward and outward, hence device to elevate same from underlying lung tissue was no longer required. Pleurobronchial fistula remains closed, and the cavity is practically sterile.

February 2, 1922. Plastic closure of anterior aspect of wound; muscle and skin and a closure of the upper posterior aspect, muscle and skin with silkworm gut sutures; rubber dam drainage for twenty-four hours. Multiple scarifications of skin to cause relaxation along the suture line and prevent slough. Lower aspect of cavity left open for active Dakinization.

February 27, 1922. Further secondary closure and re-suture of small areas along posterior aspect left open for drainage. Multiple scarifications of skin to cause relaxation of suture line. Lowermost aspect of wound still left open for Dakinization.

March 23, 1922. Additional closure of posterior aspect of wound, muscle and skin, leaving only a small area at lowermost aspect to heal by granulation, this area being so superficial that plastic flap does not seem necessary. However, if required, plastic skin flap will be sutured over area.

March 30, 1922. Wound all but healed. General condition is good; patient has begun to take on weight. Lung expanded; all cavity formation has been obliterated.

June 12, 1922. Sliding flap graft of skin and subcutaneous tissue into unhealed area. Plastic closure remaining structures. Multiple scarification of skin to cause relaxation. Rubber dam drainage for forty-eight hours.

June 26, 1922. Patient all but healed at present time.

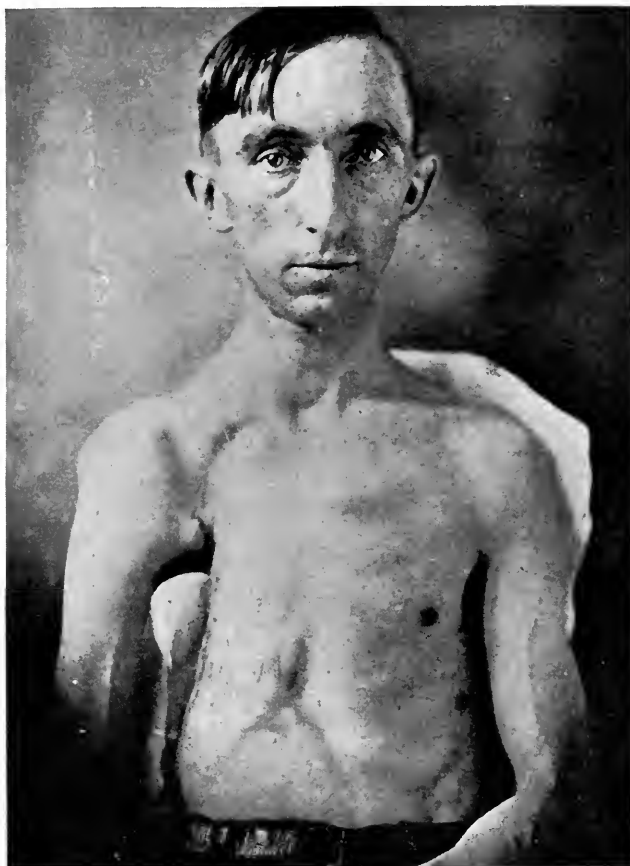


FIG. 38.—Case XVII. Pad to hold angle of scapula away from side of chest.

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Osteomyelitis.
3. Pleurobronchial fistula.
4. Cold abscess and condition of tissues, although sputum has been negative, gives tuberculosis to be reckoned with.
5. Mechanics necessary to obliterate cavity.
6. Patient's general debilitated condition with faulty metabolism; patient only able to withstand a few minutes on table.



FIG. 39.—Case XVII. Showing clavicle shortened two inches.

oped empyema; January 1, 1919, hæmolytic streptococcus type

January 15, 1919. Area of previous thoracotomy reopened and drainage instituted with irrigation by Dakin's solution. Treated by this method and reopened a number of times.

Admitted to Empyema Service, June 4, 1921.

Condition on admission. Ambulatory case; fairly well nourished, but showing some anæmia and slightly under weight. Normal weight 150 pounds; present weight 140 pounds. Fingers clubbed and some œdema of extremities.

Examination of chest revealed sinus discharging pus, seventh interspace, mid-

Patient healed. Will be kept under observation two months.

C A S E  
XVIII.—J. K., age twenty-five years, received penetrating gunshot wound right chest, machine-gun bullet, July 18, 1918, in action. July 20, 1918, debridement operation. Was aspirated six times and a serosanguinous fluid withdrawn.

December 13, 1918. Operation.—Exploratory thoracotomy seventh and eighth ribs, mid-axillary line. Bullet removed and wound closed. Numerous aspirations followed. Devel-



axillary line, right chest, with a large cavity formation partially filled with pus. Radiographs showed marked collapse of right lung with extensive thickening of the parietal pleura, right lateral chest from apex to base and a cavity formation extending from the second to the tenth ribs with a capacity of 600 c.c. and osteomyelitis of rib stumps which had been previously resected. (Fig. 40.)

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 12,600; red blood-cells, 4,560,000; urine negative; culture from cavity shows hæmolytic streptococci. Blood-pressure: systolic, 115; diastolic, 70; pulse-pressure, 45; vital capacity reading, 1600 c.c.

*Surgical Treatment, Fractional Procedure.*—June 9, 1921. Resection of 10 cm. of sixth, seventh and eighth ribs, mid-axillary line, right chest: excision of thickened parietal pleura forming roof of cavity; skin inverted over muscles that were severed and same fixed over rib stumps to prevent retraction and preserve same for final closure. Cavity left wide open for active Dakinization. (Fig. 41.)

June 30, 1921. Resection of sixth, seventh, eighth and ninth ribs, 10 cm. posterior scapular line; excision of thickened parietal pleura en masse; skin fixed over severed muscles; cavity left wide open for active Dakinization.

July 25, 1921. Resection of 10 cm. of fourth and fifth ribs, posterior scapular line; cavity left wide open and active Dakinization continued.

November 2, 1921. Resection of 15 cm. of sixth, seventh, eighth and ninth ribs, anterior axillary line; removal of roof of cavity; active Dakinization continued.

October 3, 1921. Resection of 20 cm. of eighth, ninth and tenth ribs; removal of roof of cavity; discission of visceral pleura and Dakinization continued.



FIG. 40.—Case XVIII. Condition on admission.

February 27, 1922. Resection of 20 cm. of fourth and fifth ribs anterior axillary line; removal of necrosed sixth and seventh rib stumps, same line and resection of 10 cm. of third rib posterior scapular line. Active Dakinization continued.

March 9, 1922. Secondary closure of upper aspect of cavity, muscle and skin, with the implantation of a portion of the infraspinatus muscle into apex of cavity; severed superficial muscles which have been saved brought in apposition and sutured. Excision of all scar formation and skin closed by silkworm



FIG. 41.—Case XVIII. Showing extent and result of primary operation.

gut suture. Rubber dam drainage along suture line; discission of entire visceral pleura before closure, and lower aspect of cavity left open for active Dakinization.

May 11, 1922. Plastic closure, partial, of empyema cavity, right chest; muscle and skin, with implantation of superficial muscle body into remaining space after maximum lung expansion had been obtained. Skin and muscle brought in apposition by means of silkworm gut. Multiple scarification of the skin to cause relaxation and rub-

ber dam drainage used for forty-eight hours. (Fig. 42.)

June 28, 1922. Plastic closure, muscle and skin, posterior aspect of cavity; muscle and skin brought in apposition and sutured by means of silkworm gut; rubber dam drainage for forty-eight hours; multiple scarification of skin to cause relaxation. Patient will be kept under observation for a period of two months. (Fig. 43.)

Factors to be combated in this case are:

1. Hæmolytic streptococcus organisms present.
2. Osteomyelitis of ribs.
3. Diverticulæ or secondary cavities.
4. Constitution psychopath.
5. Myocarditis, chronic.

## TREATMENT OF CHRONIC EMPYEMA

Patient healed; will be kept under observation two months prior to disposition.

CASE XX.—H. S. J., aged twenty-six years, developed influenza and pneumonia, January 10, 1918, complicated by empyema, right pleural cavity, hemolytic streptococcus type, January 20, 1918. Aspirated twice.

January 24, 1918. Thoracotomy with resection of portion of seventh rib, mid-axillary line, with the institution of drainage for five months without irrigation, followed by irrigation with Dakin's solution for two weeks.

June 19, 1918. Additional rib resection; institution of better drainage.

November 11, 1918. Resection of portion of eighth and ninth ribs to allow better drainage and daily irrigation with Dakin's solution.



FIG. 42.—Case XVIII. Taken at the time of partial closure.

February 19, 1920. Resection of sixth, seventh, eighth and ninth ribs, right chest, mid-axillary line; partial decortication of visceral pleura. Removal of portion of thickened parietal pleura; cavity closed; rubber tube drain.

June 3, 1920. Cavity reopened and further decortication was done in an attempt to obliterate cavity, lower aspect being left open for Dakinization.

Admitted to Empyema Service, November 10, 1920.

Condition on admission: Ambulatory case; anæmic, highly septic, poorly nourished and considerably under weight; normal weight 145 pounds; present weight 111 pounds; fingers clubbed; extremities œdematous. Examination of chest reveals sinus discharging pus, posterior axillary line, marked deformity of contour of right chest, due to previous operations. Radiograph shows marked collapse of right lung with extensive thickening of pleura from apex to base and a bismuth-filled cavity, extending from second rib to mid-axillary line, with multiple diverticuli, draining into main cavity. Capacity of cavity 200 c.c. Pleurobronchial fistula present, the communication being almost direct to the hilus of the lung. Osteomyelitis of rib stumps present.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 12,600; red blood-cells, 3,750,000; urine showed trace of albumin; culture from cavity showed heavy growth of hæmolytic streptococcus. Blood-pressure: systolic, 110; diastolic, 80; pulse-pressure, 30; vital capacity reading, 1500 c.c.

*Surgical Treatment, Fractional Procedure.*—November 17, 1920. Resection of fifth, sixth, seventh and eighth ribs, posterior scapular line, right chest; excision of thickened parietal pleura and scar tissue; cavity laid wide open; multiple

diverticulum noted and roofs of same excised. Preparation of cavity for active Dakinization. (Fig. 44.)

December 6, 1920. Resection of 10 cm. of third, fourth and fifth ribs; cavity laid wide open; Dakinization continued.

January 12, 1921. Excision of another diverticulum or sinus tract draining into main cavity; Dakinization continued.

March 31, 1921. Excision of old scar, lower aspect of cavity, and an additional portion of the eighth rib resected which had become osteomyelitic.



FIG. 43.—Case XVIII. Final result. Posterior shadow is not an opening.

May 17, 1921. Incision anterior axillary line; resection of parts of fifth, sixth and seventh ribs. Three additional sinus tracts found and excised; active Dakinization continued.

June 23, 1921. Resection of third and fourth ribs, anterior axillary line; removal of roof of cavity; dakinization continued; discission of visceral pleura and mobilization of lung about bronchial fistula.

July 27, 1921. Incision along old posterior scar, apex of cavity exposed posteriorly; Dakinization continued.

October 3, 1921. Resection of 5 cm. of third rib, posterior scapular line; excision of the thickened parietal pleura. Discission of the visceral pleura

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and mobilization of the lung about the bronchial fistula; active Dakinization was continued.

January 12, 1922. Resection of regenerated stumps of third, fourth and fifth ribs, anterior to posterior axillary line. Portion of subscapularis muscle implanted over fistula after lung had been mobilized about same. Anterior aspect of cavity closed; superficial muscle brought in apposition and sutured; skin closed by means of silkworm gut. Multiple scarification of skin to cause relaxation. Posterior aspect of cavity left open for dakinization.

March 3, 1922. Secondary closure with implantation of portion of latissimus dorsi into remaining cavity which was not obliterated by lung expansion, fistula having remained closed following last operation and cavity sterile. Superficial muscles brought in apposition and sutured; skin closed by means of silkworm gut; rubber dam drainage for twenty-four hours; multiple scarification of skin to cause relaxation. (Fig. 45.)

April 1, 1922. Patient improving, but has small area of tenth rib showing osteomyelitis, which will require resection at a future date.

May 5, 1922. Operation.—Resection of 10 cm. of tenth rib, posterior axillary line, right chest and excision of sinus tract leading down to same. Entire area left wide open for active Dakinization.

June 26, 1922. Patient entirely healed, fistula closed; all cavity formation obliterated; lung well expanded; general condition excellent; weight on admission was 111 pounds; present weight is 122 pounds; vital capacity reading, 2200 c.c. (Fig. 46.)

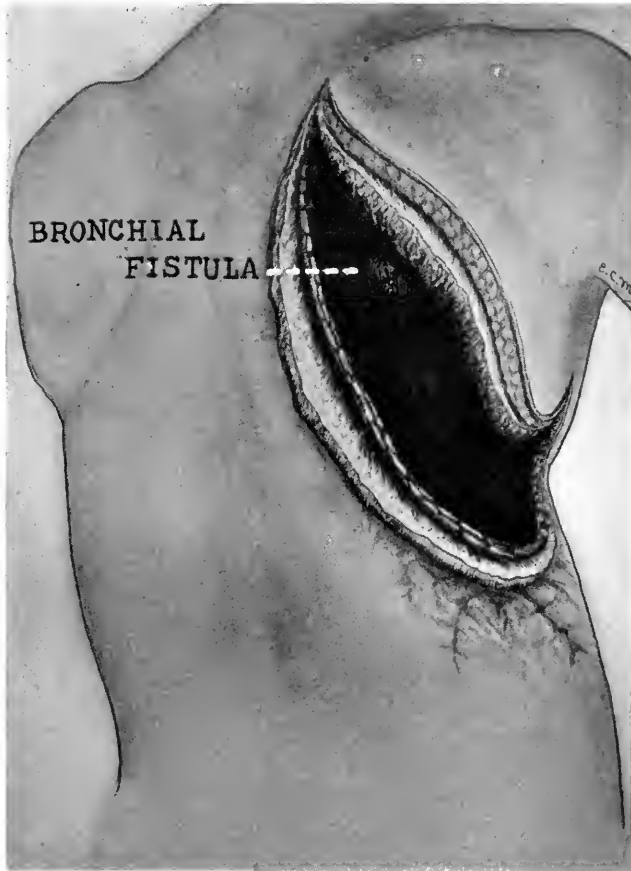


FIG. 44.—Case XX. Showing situation of bronchial fistula, and extent of defect.

Factors to be combated in this case are:

1. Hæmolytic streptococcus infection.
2. Osteomyelitis of rib stumps.
3. Secondary cavities and diverticulæ.
4. Pleurobronchial fistula.
5. Marked bridging and overlapping of regenerated rib formation.

June 26, 1922. Patient ready for discharge.

CASE XXI.—R. H. S., age thirty years, received a gunshot wound left chest,



FIG. 45.—Case XX. Result of secondary closure after muscle implantation.

draining; has been reopened for the institution of drainage twelve times.

Admitted to the Empyema Service, Walter Reed General Hospital, January 26, 1922.

Condition on admission: Ambulatory case, fairly well nourished, but considerably under weight; normal weight 165 pounds; present weight 145 pounds.

Examination of chest: Sinus discharging pus, eighth interspace, mid-scapular line, left chest; drainage not dependent. Radiographs showed marked collapse of left lung with a cavity formation extending from the fourth to the ninth rib with a capacity of 500 c.c. Heart considerably displaced to the right and marked thickening of the parietal pleura, left lateral chest, from second rib to base.

penetrating sixth interspace nipple line, in action, November 1, 1918; developed influenza November 4, 1918, which was complicated by pneumonia, November 10, 1918, and this was complicated by empyema, left pleural cavity, hæmolytic streptococcus type, November 17, 1918. Aspirated four times.

November 15, 1918. Operation, Thoracotomy.—Resection of a portion of the eighth rib, mid-scapular line, with the institution of drainage.

March 22, 1919. Discharged from the service still

## TREATMENT OF CHRONIC EMPYEMA

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 8050; red blood-cells, 4,810,000; urine negative; culture from cavity shows hæmolytic streptococcus and staphylococcus aureus. Blood-pressure: systolic, 106; diastolic, 74; pulse-pressure, 32; vital capacity reading, 2000 c.c.

*Surgical Treatment, Fractional Procedure.*—January 31, 1922. Operation.—Resection of 15 cm. seventh, eighth and ninth ribs, mid-scapular line, left chest; excision of thickened parietal pleura forming roof of cavity; skin inverted over severed muscles and fixed over resected rib stumps to render dressings less painful and preserve structures for future closure, multiple scarifications of skin to cause relaxation; preparation of cavity for active Dakinization. (Fig. 47.)

February 13, 1922. Operation.—Resection of 15 cm. of fourth, fifth and sixth ribs, posterior axillary line, left chest; removal of thickened parietal pleura forming roof of cavity; discission of visceral pleura to allow lung expansion; skin inverted over muscles that were cut



FIG. 46.—Case XX. Final result.

and preserved for future closure; entire cavity left open for active Dakinization.

March 8, 1922. Cavity is now one-fourth its original size and the lung is still expanding; bacterial examination shows only a few colonies of staphylococcus aureus. We will soon be ready for further operative procedure.

April 5, 1922. Plastic closure muscle and skin with the implantation of a portion of the latissimus dorsi into remaining space after maximum lung expansion had been obtained. Skin and superficial muscles brought into apposition and sutured with silkworm gut. Scarification of skin to cause relaxation; rubber dam and tube drainage for twenty-four hours.



FIG. 48.—Case XXI, Final result.



FIG. 47.—Case XXI, Showing one stage of obliterative process.



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May 1, 1922. Patient entirely healed; condition excellent. Taken on weight since first operation. Lung well expanded. All cavity formation obliterated.

June 12, 1922. Healed; condition excellent; 165 pounds; vital capacity, 3400 c.c. (Fig. 48.)

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Osteomyelitis with rib sequestration.
3. Secondary cavity.

Discharged cured, June 12, 1922.

CASE XXIII.—C. J. W., age twenty-seven years, developed pneumonia, January 5, 1918; complicated by empyema, right pleural cavity, hæmolytic streptococcus type. January 12, 1918, aspirated eight times.

January 22, 1918. Thoracotomy—resection of 10 cm. of eighth rib, posterior axillary line, right chest. Rubber tube valve inserted for drainage and Carrel tubes used to instill Dakin's solution.

Remained under treatment by this method until May 15, 1919, when he was discharged from the service with an open sinus still discharging pus.

Returned to his home and remained there under treatment by a private physician; chest reopened nine times to institute drainage of accumulation of pus,

Admitted to Empyema Service, August 11, 1921.

Condition on admission: Ambulatory case, poorly nourished and considerably under weight; normal weight 162 pounds; present weight 123 pounds. Examination of chest revealed sinus discharging pus eighth interspace, posterior axillary line, right chest. Radiographs showed marked collapse of right lung with extensive thickening of pleura, lateral chest from second rib to base, and a cavity formation noted from fourth to tenth rib. A piece of rubber tubing  $2\frac{1}{2}$  inches in length observed in the lower aspect of cavity. Pleurobronchial fistula present and the capacity of cavity 400 c.c. Osteomyelitis with sequestration of the eighth and ninth ribs with fusion and overlapping of same present. (Fig. 49.)

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; W.B.C., 9200; R.B.C., 4,500,000; urine showed trace of albumin; culture from cavity showed heavy growth of hæmolytic streptococci. Blood-pressure: systolic, 142; diastolic, 84; pulse-pressure, 58; vital capacity reading, 1800 c.c.

*Surgical Treatment, Fractional Procedure.*—October 12, 1921. Operation.—Resection of seventh, eighth and ninth ribs, 15 cm. posterior axillary line, right chest; cavity laid wide open and thickened parietal pleura excised; removal of Carrel valve or rubber tube which had been in cavity over two years; discission of visceral pleura to allow lung expansion; skin inverted over muscles to preserve same for final closure and to render dressings less painful; preparation of cavity for Carrel-Dakin technic for sterilization of same.

October 31, 1921. Operation.—Resection of anterior portion of seventh rib and part of costal cartilage, with a resection of 15 cm. of eighth rib, right chest, anterior axillary line, and the removal of overlying thickened pleura exposing secondary cavity; skin and muscle preserved for future closure; discission of visceral pleura to allow lung expansion.

November 30, 1921. Operation.—Resection of 20 cm. of fifth, sixth and seventh ribs, posterior scapular line, right chest, and resection of 5 cm. of eighth, ninth and tenth ribs, with removal of thickened pleura forming roof of secondary cavity which had been sterilized, discission of visceral pleura exposed and implantation of a portion of the latissimus dorsi and subscapularis muscles into upper aspect of cavity; muscle and skin closure over this area.

January 6, 1922. Operation.—Resection of ninth, tenth and eleventh ribs, 10 cm., and excision of two sinus tracts, one following course of tenth rib and the

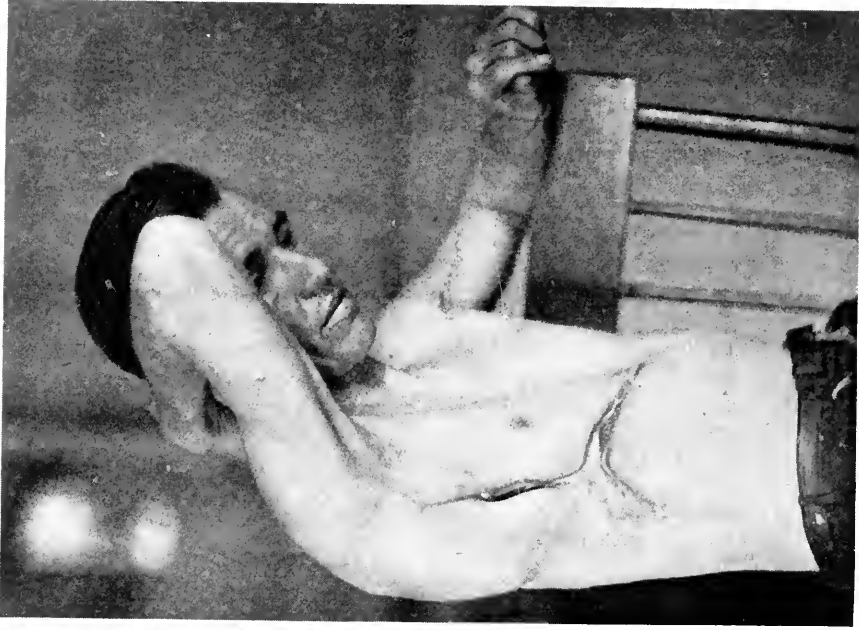


FIG. 50.—Case XXIII. Showing five subcavities; three posterior cavities obliterated; two anterior cavities still open but obliterating.

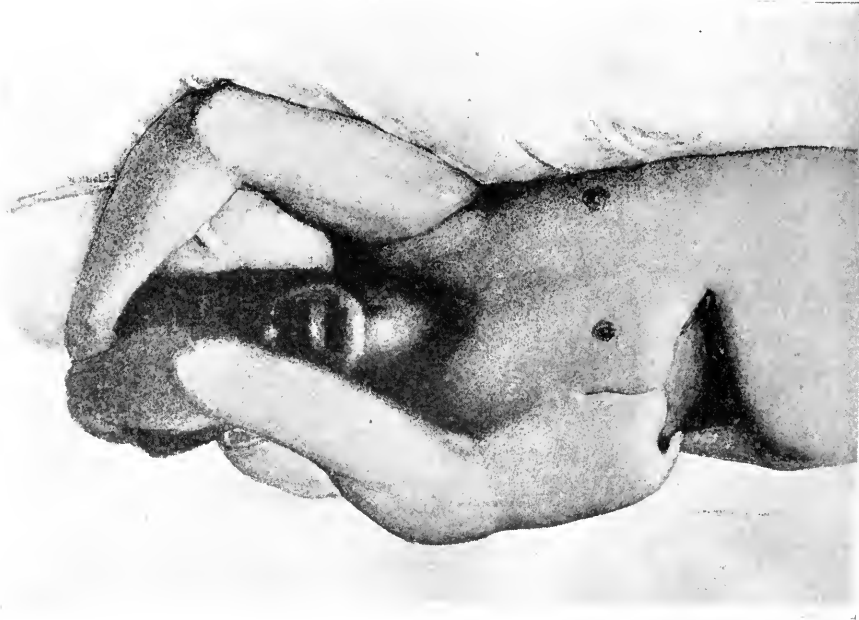


FIG. 49.—Case XXIII. Condition on admission.

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other leading down to twelfth rib, mid-axillary line, right chest. Skin inverted over the muscle, which was saved for future closure; area left open for active Dakinization.

February 6, 1922. Operation.—Resection of fourth, fifth and sixth ribs, 10 cm. anterior axillary line, right chest, with the removal of the roof of another secondary cavity and the preparation of same for active dakinization.

April 5, 1922. Partial plastic closure muscle and skin, with the implantation of portion of the superficial muscles into the upper aspect of the cavity, mid-axillary line, with injection of iodoform emulsion into same before area was closed. Lower anterior portion of secondary cavity likewise closed with the emulsion injection and skin and muscle brought in apposition and sutured with silkworm gut; multiple scarification of skin to cause relaxation; rubber dam drainage for forty-eight hours. (Fig. 50.)

June 26, 1922. Patient healed; fistula closed; all cavity formation obliterated; lung was well expanded; the general condition excel-



FIG. 51.—Case XXIII. Final result.

lent. Patient had taken on some weight; vital capacity reading, 2500 c.c.

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Carrel valve rubber drainage tube left in cavity.
3. Osteomyelitis with rib sequestration.
4. Pleurobronchial fistula.
5. Secondary cavity and diverticulæ—five in number.
6. Nephritis, chronic, interstitial.
7. Tuberculosis, supported by pathological specimen.
8. Chondritis of sixth, seventh and eighth costal cartilage.

Patient cured and ready for discharge upon his return from thirty-day leave.  
CASE XXVI.—J. W. W., age twenty-seven years, developed influenza, May 16, 1918, complicated by empyema, left pleural cavity, hæmolytic streptococcus type, June 8, 1918; aspirated once.

June 10, 1918. Operation.—Thoracotomy; resection of 10 cm. of seventh rib, anterior axillary line, left chest; pleural cavity opened and 500 c.c. of pus evacuated; rubber tube valves inserted into cavity for drainage.

October 5, 1918. Operation.—Thoracotomy. Resection of a portion of the proximal end of the seventh rib, left chest, and the institution of drainage.

January 12, 1919. Incision with institution of drainage.

September 17, 1919. Resection of a portion of the seventh rib and regenerated bone and drainage again instituted with a Dakin solution irrigation. Discharged from service February, 1920, and taken over as a Public Health patient, being treated in a number of hospitals, and was sent to Mt. Alto, Pennsylvania, for treatment of suspected tuberculosis.

Admitted to Empyema Service, December 5, 1921.

Condition on admission: Ambulatory case; poorly nourished and considerably under weight; normal weight 165 pounds; present weight 148 pounds; joints of extremities oedematous and tender; persistent cough with the expectoration of frank pus; highly septic; fingers clubbed.

Examination of chest revealed marked lagging of left side on deep inspiration; scar formation over seventh rib from the anterior to the posterior axillary line. (Fig. 52.) Percussion revealed impaired resonance to flat note from second rib to base of left chest; auscultation breath sounds distant and indistinct.

Radiographs showed marked collapse of left lung, with extensive thickening of pleura, left lateral chest, from second rib to base, and a large cavity formation filled with fluid and extending from fourth rib, posterior chest, down to ninth rib. Marked displacement of heart to the right. Pleurobronchial fistula present and patient was partially able to drain his cavity by lowering his head and coughing.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 12,700; red blood-cells, 4,200,000; urine negative; culture from cavity showed heavy growth of hæmolytic streptococcus. Blood-pressure: systolic, 122; diastolic, 80; pulse-pressure, 42; vital capacity reading, 2000 c.c.

*Surgical Treatment, Fractional Procedure.*—December 14, 1921. Operation.—Resection of sixth, seventh, eighth and ninth ribs, 20 cm. posterior axillary line, left chest; cavity laid wide open and the evacuation of 500 c.c. of pus; the thickened parietal pleura forming roof of cavity excised. Discission of the visceral pleura to allow lung expansion and to mobilize the lung about fistula; skin inverted over muscle to preserve same for final closure and preparation of cavity for the Carrel-Dakin technic for sterilization of same.

January 5, 1922. Discission of visceral pleura and the treatment of fistula with a two per cent. alcoholic solution of gentian violet to mechanically plug the same until granulations entirely obliterate communication.

February 20, 1922. Cavity entirely obliterated, pleurobronchial fistula closed, and wound sterile by seven consecutive daily cultures.

February 24, 1922. Operation.—Secondary closure, partial upper and posterior aspect of wound closed—muscle and skin with silkworm gut and rubber dam drainage.

March 8, 1922. Operation.—Secondary closure, lower aspect of wound, all scar tissue removed, and muscle and skin brought in apposition and sutured. Rubber dam drainage and multiple scarification of skin to cause relaxation and relieve tension.



FIG. 52.—Case XXVI. Condition on admission.

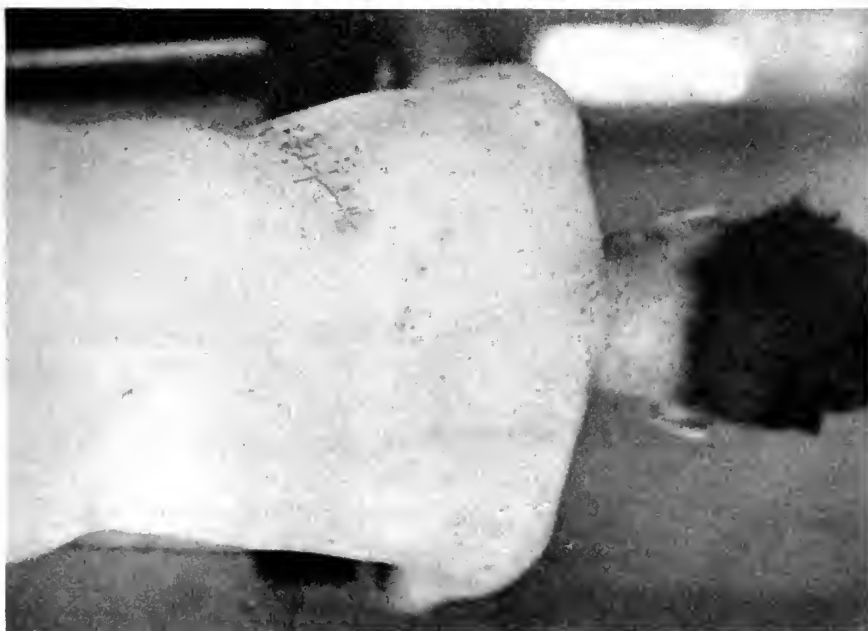


FIG. 53.—Case XXVI. Final result.

March 20, 1922. Patient entirely healed; condition excellent. Weight on admission 148 pounds; weight at present 170 pounds; vital capacity reading, 3200 c.c. (Fig. 53.)

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Pleurobronchial fistula present.
3. Osteomyelitis with sequestration of rib.

June 15, 1922. Patient entirely cured; healed two months; condition excellent; patient discharged.

CASE XXVIII.—R. F. L., age twenty-eight years, was gassed in action in Argonne Forest (patient's statement), October 13, 1918, and was treated in hospital until December, 1918. Discharged from service, February 27, 1919. Developed influenza and pneumonia, March 1, 1919, complicated by empyema, left pleural cavity, hæmolytic streptococcus type, March 20, 1919; aspirated twice.

Operation March 28, 1919. Thoracotomy; resection of a portion of the eighth rib, posterior axillary line, with the institution of drainage.

June 8, 1920. Thoracotomy; resection of a portion of the seventh rib, posterior axillary line, and the removal of regenerated eighth rib in the area of operation with the institution of drainage.

October 29, 1920. Operation.—Resection of an additional portion of the anterior stumps of the seventh and eighth ribs, with the institution of drainage.

Patient states that he was reopened to institute drainage eleven times in addition to the above operations.

Admitted to Empyema Service, January 20, 1922.

Condition on admission: Ambulatory case; poorly nourished and considerably under weight; normal weight 140 pounds; present weight 117 pounds. Extremities oedematous and patient showing the facies of sepsis. Fingers clubbed and marked anæmia present. Examination of chest revealed sinus discharging pus, seventh interspace, posterior axillary line, left chest; pleurobronchial fistula present.

Radiographs showed marked collapse of left lung; extensive thickening of the parietal pleura from apex to base left lateral chest and a large cavity partially filled with pus extending from third rib to ninth rib, with a capacity of 450 c.c., the upper aspect of same only communicating with the main cavity by means of a small sinus.

Bacteriological examination: Wassermann plus minus, had been double plus and had received two courses of antisyphilitic treatment. Sputum negative for tubercle bacilli. White blood-cells, 18,550; red blood-cells, 4,130,000; urine showed trace of albumin; culture from cavity showed hæmolytic streptococci. Blood-pressure: systolic, 110; diastolic, 74; pulse-pressure, 36; vital capacity reading, 1700 c.c.

*Surgical Treatment, Fractional Procedure.*—January 23, 1922. Operation.—Resection of 20 cm. of sixth, seventh, eighth and ninth ribs, posterior axillary line, left chest; removal of thickened parietal pleura and the excision of thick bands of fibrous tissue dividing the main cavity into three subcavities; the fistula exposed and the skin inverted over the severed muscles; cavity left open for active Dakinization.

February 23, 1922. Operation.—Resection of 20 cm. of fourth and fifth ribs and 5 cm. of the posterior stumps of the sixth and seventh ribs; excision of parietal pleura forming roof of secondary cavity; dissection of visceral pleura to allow expansion; cavity left wide open for active Dakinization; skin inverted over severed muscles and fixed over rib ends to prevent retraction and to render dressing less painful, with multiple scarifications of skin to relieve tension.

March 8, 1922. Fistula closed by means of repeated applications of a two per

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cent. alcoholic solution of gentian violet; cavity cleaning up; patient's general condition greatly improved; all œdema has disappeared from extremities; will soon be ready for further operative procedure.

March 23, 1922. Resection of 10 cm. of third and fourth ribs, posterior scapular line; removal of roof of secondary cavity and remaining sinus injected with iodoform emulsion; muscle implantation into apex of cavity to obliterate the remaining space, and continuation of the active Dakinization of the entire cavity.

June 9, 1922. Resection of a portion of second, third, fourth, fifth and sixth ribs, posterior scapular line, left chest; excision of thickened parietal pleura forming roof of cavity; entire secondary cavity exposed and complete area left open for active Dakinization.

June 26, 1922. Patient on active Dakinization; entire cavity wide open. Bacterial count shows several no-growth cultures. All œdema of feet and ankles has cleared up. General condition greatly improved.

This patient has been undergoing vigorous syphilitic treatment and for that reason the cavity has been left open.

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Thickened pleura.
3. Faulty drainage.
4. Scoliosis.
5. Accessory cavity.

CASE XXXI.—W. R., age twenty-eight years, developed pneumonia February 1, 1917, complicated by empyema, right pleural cavity, hæmolytic streptococcus type, February 11, 1917; aspirated three times.

February 14, 1917. Operation.—Thoracotomy with resection of a portion of the ninth rib, posterior axillary line, and the institution of drainage. Patient healed March 6, 1918, and entered the military service May 28, 1918. Remained on active duty without recurrence until June 28, 1919, when he was discharged from the service. July 6, 1919, developed a recurrence of empyema.

July 8, 1919. Operation.—Incision and drainage, and irrigation with Dakin solution daily. Has healed and been reopened at least fifteen times.

Admitted to Empyema Service, March 29, 1922.

Condition on admission: Ambulatory case; well nourished; normal weight, but slightly anæmic and highly septic; weight on admission 180 pounds.

Examination of chest revealed sinus discharging pus, ninth interspace, mid-scapular line, right chest; radiograph showed some collapse of the right lung and extensive thickening of the parietal pleura from apex to base, right lateral chest. Cavity formation extending transversely from seventh to ninth rib with a capacity of 250 c.c.

Bacteriological examination: Wassermann double plus; sputum negative for tubercle bacilli; red blood-cells, 4,110,000; white blood-cells, 10,700; hæmoglobin, 80 per cent.; urine negative; culture from cavity shows hæmolytic streptococci. Blood-pressure: systolic, 130; diastolic, 80; pulse-pressure, 50; vital capacity reading, 2000 c.c.

*Surgical Treatment, Fractional Procedure.*—March 31, 1922. Resection of 20 cm. seventh, eighth and ninth ribs, posterior axillary line, excision of thickened parietal pleura. Entire cavity laid wide open; two diverticulæ draining into main cavity were excised. Implantation of a portion of the serratus magnus into the anterior aspect of the cavity. Skin inverted over superficial muscles and fixed; multiple scarification of skin to cause relaxation; preparation of cavity for active Dakinization. (Fig. 54.)



FIG. 55.—Case XXXI, Final result.



FIG. 54.—Case XXXI, Condition during muscular implantation.



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April 17, 1922. Resection of 10 cm. of the ninth and tenth ribs, mid-axillary line, to remove osteomyelitic involvement. Skin inverted over superficial muscle; entire cavity left wide open for continued Dakinization.

May 31, 1922. Excision of sinus tract draining into main cavity. Removal of a sequestrum or detached particles of rib fragments in area of seventh rib; entire area left open for continued Dakinization.

June 21, 1922. Plastic closure, muscle and skin; implantation of portion of superficial muscle body into remaining space after maximum lung expansion had been obtained; all scar tissue excised; severed muscles and skin brought in apposition by means of silkworm gut sutures; rubber dam drainage for forty-eight hours; multiple scarification of skin to cause relaxation.

June 28, 1922. All sutures removed and area healed by primary intention. (Fig. 55.) Lung is well expanded; general condition is excellent; vital capacity 3400 c.c. This case will be kept under observation for two months before final disposition.

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Osteomyelitis with sequestration.
3. Diverticulæ and numerous sinus tracts draining into remaining cavity.
4. Syphilis, tertiary, manifested by double plus Wassermann.
5. Profuse acne.

CASE XXXVIII.—A. M., age twenty-seven, developed influenza, October 23, 1918, followed by pneumonia, October 27, 1918, and the latter complicated by empyema, left pleural cavity, hæmolytic streptococcus type, November 2, 1918. Four operations prior to admission to this hospital with partial resection eighth and ninth ribs, left side.

Condition on admission: Patient anæmic, considerably under weight—normal weight 168 pounds; present weight 131 pounds; poorly nourished, highly septic.

Examination of chest showed sinus draining pus at the level of the ninth rib, mid-scapular line, left chest.

Radiograph revealed cavity extending from the level of the ninth rib, posterior, to the third rib, posterior, about 4.5 cm. at its widest portion. The cavity is spindle shaped. There has been resection of parts of the eighth and ninth ribs posterior, with regeneration of the bone joining the resected ends. Marked collapse of left lung with thickened pleura from base to apex. Pneumothorax most marked in the upper portion of the left chest. Heart, aorta and mediastinal contents are displaced markedly to the right.

Bacteriological examination: Wassermann negative; urine negative; sputum negative for tubercle bacilli; red blood-cells, 4,000,000; white blood-cells, 7000; hæmoglobin, 85 per cent.; culture from cavity shows streptococcus hæmolyticus.

*Surgical Treatment, Fractional Procedure.*—November 10, 1920. Resection of 20 cm. of the third to sixth ribs, left. The sinus tract was excised and the cavity laid wide open over this area. Preparation for active Dakinization.

December 27, 1920. The lower part of the cavity was attacked and about 20 cm. of the seventh, eighth and ninth ribs were resected. Cross-formation with necrosis was found in this area. This part of the cavity being laid widely open, the whole of the latter was now exposed to view.

The cavity soon cleaned up under active Dakinization. The obliteration of the wound proceeded at a rapid rate. This was aided by linear scarifications of the visceral pleura at weekly intervals. The depth of the wound gradually decreased largely by the reëxpansion of the previously collapsed lung.

April 27, 1921. The cavity had diminished in all dimensions so that its capacity was less than one-fourth its original size. Patient gained in weight and strength. General condition markedly improved.

May 15, 1921. The cavity was entirely obliterated in its lower aspect and the upper angle showed only a superficial wound, the floor of which was formed by the visceral pleura. A plastic operation was contemplated, with excision of the scar tissue and establishing the continuity of the muscle bodies lying on either side of the old wound. However, patient considered himself practically well and requested discharge. Patient discharged June 3, 1921.

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.
2. Osteomyelitis of rib stumps.
3. Marked collapse of left lung with thickened pleura from apex to base.

CASE XXXIX.—R. L. S., age twenty-one years, developed influenza, February 26, 1920, complicated by bronchopneumonia, March 5, 1920, and later complicated by empyema, left pleural cavity, hæmolytic streptococcus type, March 18, 1920; aspirated six times.

March 24, 1920. Operation.—Intercostal thoracotomy, eighth interspace, anterior axillary line, with institution of drainage and irrigation with Dakin's solution.

August 12, 1920. Operation.—Thoracotomy; resection of 10 cm. of seventh and eighth ribs, anterior axillary line, cavity left open for irrigation with Dakin's solution.

Admitted to the Empyema Service of the Walter Reed General Hospital, September 24, 1920.

Condition on admission: Ambulatory case, poorly nourished and considerably under weight; normal weight 130 pounds; present weight 115 pounds.

Examination of chest reveals sinus discharging pus, anterior axillary line, left chest; pleurobronchial fistula present and a large cavity formation extending up to second rib, anterior aspect, left chest. A large cavity formation noted extending from second rib to base, with a capacity of about 500 c.c.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 6250; red blood-cells, 4,700,000; urine negative; culture from cavity showed hæmolytic streptococcus and proteus. Blood-pressure: systolic, 132; diastolic, 74; pulse-pressure, 58; vital capacity reading, 1600 c.c.

*Surgical Treatment, Fractional Procedure.*—November 5, 1920. Operation.—Resection of 20 cm. of fourth, fifth, sixth, seventh and eighth ribs, left chest, mid-axillary line, with the roof of cavity excised and pleurobronchial fistula exposed. Skin inverted over muscles that were severed and fixed over rib stumps to preserve same for final closure and render dressing less painful. Cavity left open for active Dakinization. (Fig. 56.)

December 1, 1920. Operation.—Resection of 10 cm. of second and third ribs, anterior axillary line, left chest, with a plastic closure of the upper aspect of cavity with a portion of the pectoralis minor muscle; the severed superficial muscles and skin brought in apposition and sutured. The lower aspect of the cavity was left open for drainage and Dakinization.

December 2, 1920. Operation.—Enlargement of drainage opening in lower aspect of cavity and preparation of same for active Dakinization.

January 31, 1921. Operation.—Resection of 10 cm. of eighth and ninth ribs, anterior axillary line, left chest; bronchial fistula closed by suture and implanting muscle over same; sinus tract excised. (Fig. 57.)

April 28, 1921. Operation.—Mobilization of lung about fistula and closure of fistulous tract by means of purse-string suture, plastic closure of lower aspect of cavity leaving ample drainage.

September 29, 1921. Operation.—Excision of scar and superficial ulcer over lower aspect of plastic closure.

FIG. 56.—Case XXXIX. Showing bronchial fistula and extent of defect.

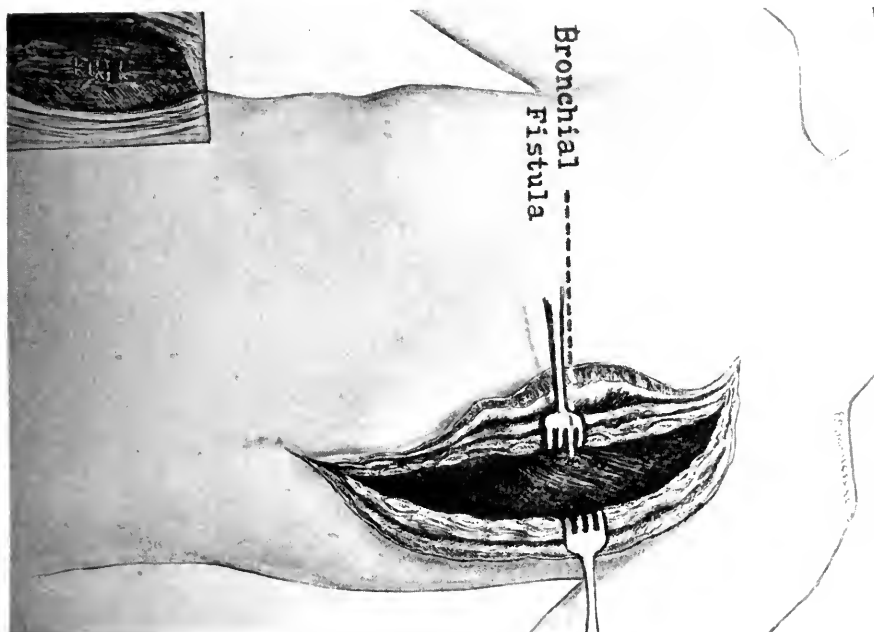


FIG. 57.—Case XXXIX. Fistula closed.



November 20, 1921. Patient entirely healed, general condition excellent. Has taken on weight since his first operation; X-ray shows total obliteration of all cavity formation and the lung well expanded.

December 6, 1921. Healed and in excellent physical condition. Weight at present is 135 pounds; vital capacity reading, 2300 c.c. Granted sixty-day leave.

March 1, 1922. Condition steadily improving.

May 15, 1922. Discharged completely cured; healed five months. (Fig. 58.)



FIG. 58.—Case XXXIX. Final result.

Factors to be combated in this case are:

1. Hæmolytic streptococcus organism present.

2. Osteomyelitis with rib sequestration.

3. Pleuro-bronchial fistula present.

CASE XL.—  
H. G. C., aged twenty-six years, developed pneumonia, January 25, 1918, complicated by empyema, right pleural cavity, hæmolytic streptococcus type, January 27, 1918; aspirated three times.

Received seven operations prior to his admission to this hospital, with resection

of the fifth to tenth rib inclusive, right chest. Received active Dakinization and continuous treatment.

Admitted to Empyema Service, Walter Reed Hospital, March 29, 1922.

Condition on admission: Ambulatory case, fairly well nourished, quite septic and slightly under weight.

Examination of chest: Marked disturbance in contour of right chest, posterior lateral aspect due to previous operative procedure. There is a sinus discharging pus, seventh interspace, posterior axillary line, and a narrow cavity formation extending from the fifth to the tenth rib, same line. A partial collapse of the right lung is noted, and some osteomyelitis of the previously resected rib stumps.

## TREATMENT OF CHRONIC EMPYEMA

There is a regeneration with bridging and overlapping of the previously resected ribs. Capacity of cavity, 300 c.c.

Radiographic examination supports the above findings.

Bacteriological examination: Wassermann negative; sputum negative for tubercle bacilli; white blood-cells, 13,700; red blood-cells, 4,280,400; hæmoglobin, 75 per cent.; urine negative. Culture from cavity shows hæmolytic streptococcus, and staphylococcus aureus. Blood-pressure: systolic, 136; diastolic, 80; pulse-pressure, 56; vital capacity reading, 1800 c.c.

*Surgical Treatment, Fractional Procedure.*—April 10, 1922. Operation.—Resection of regenerated rib stumps from the fifth to the tenth rib inclusive; entire cavity laid open. Multiple fistulous tracts excised. Skin inverted over severed superficial muscles and fixed. Multiple scarifications of skin to cause relaxation along suture line. Implantation of a portion of the deep fascia into the apex of the exposed tract. Preparation of the entire cavity for active Dakinization.

May 17, 1922. Operation.—Resection of a mass of regenerated bone *in situ* of cavity and removal of an additional portion of the ninth rib, posterior aspect, with excision of sinus tract leading down under same. The entire cavity left open for continuous Dakinization.

June 7, 1922. Operation.—Plastic closure, muscle and skin, of entire space remaining, following maximum lung expansion, with the implantation of a portion of the latissimus dorsi muscle into said space. Muscle and skin brought into apposition by means of silkworm gut sutures; Carrel tube and rubber dam drainage for twenty-four hours. Multiple scarifications of skin to cause relaxation.

June 20, 1922. All sutures and drainage having been removed and entire structure healed, patient feeling well, lung well expanded and all cavity obliterated, will be placed on calisthenics and deep breathing exercises before he is discharged from hospital.

## CHRONIC CATARRHAL CHOLECYSTITIS WITH LIPOID DEPOSIT

By JOHN R. CORKERY, M.D.

OF SPOKANE, WASH.

CHRONIC catarrhal cholecystitis has had extensive investigation from the pathological standpoint.\* This paper further purposes to consider papilloma of the gall-bladder. The material for the paper was gathered in part in the study made at the Mayo Clinic on early lesions of the gall-bladder and on fish-scale gall-bladder, in part from cases in my own practice and part from pathological specimens from the practices of others. The methods of preparing material for study have been heretofore described.<sup>4</sup>

Papillomata of the gall-bladder occur as single or multiple lesions of the mucosa. They appear in white, yellowish bunches, grapelike bodies, insecurely attached to the mucosa by a very slender filament of tissue and are from .5 mm. to 5 mm. in diameter. These are easily brushed off. They are found upon microscopic study to be composed of a papilloma-like mass. The cellular changes present are identical with those which are found in forms of chronic catarrhal cholecystitis with lipoid deposit, namely, fish-scale and strawberry gall-bladder. Briefly reviewed, they are the following:

(1) Distortion of the villi due to infiltration of leucocytes, fibrosis, and lipoid deposit and other products of inflammation.

(2) The mucosa is always intact except for artefact.

(3) The lipoid substance is seen in the type of the epithelial cells lining the lumen and the acini, around the nuclei, and in the base, just under the base of the epithelial cells, in large polygonal cells or round cells in the sub-mucosa, sparingly in connective-tissue cells and muscle cells, in leucocytes in the stroma, in the walls of blood-vessels and in the lumen. The lipoid is usually deposited in fine granules, but may become so packed that the granules disappear and the mass is homogeneous. The polygonal shape of the large cells in the submucosa is due to their being tightly packed with lipoid in a space too small for the spherical shape to be retained.

(4) Round-cell infiltration is noted in amounts proportional to the amount of lipoid deposited.

(5) Polymorphonuclear leucocytes are often noted, but the picture is that of an acute infection engrafted on a chronic infection.

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\* Among other pieces of work are—

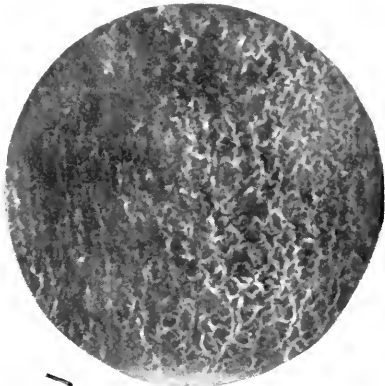
<sup>1</sup> MacCarty, W. C.: Strawberry Gall-bladder. *ANNALS OF SURGERY*, 1910.

<sup>2</sup> Irwin and MacCarty: Papilloma of Gall-bladder. *ANNALS OF SURGERY*, 1915.

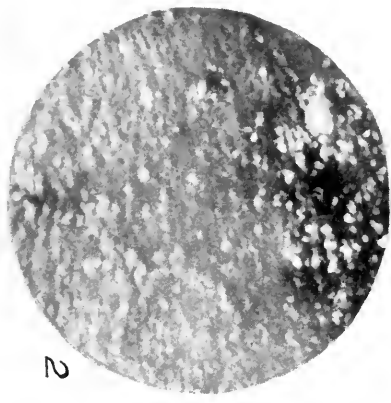
<sup>3</sup> MacCarty and Corkery: Early Lesions of Gall-bladder. *American Journal of Medical Sciences*, 1920.

<sup>4</sup> Corkery, J. R.: Fish-scale Gall-bladder. *ANNALS OF SURGERY*, 1920.

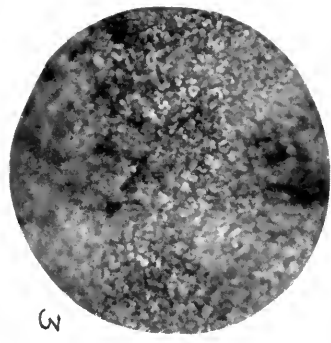
<sup>5</sup> MacCarty: The Pathology of Gall-bladder and some Associated Lesions. *ANNALS OF SURGERY*, 1910.



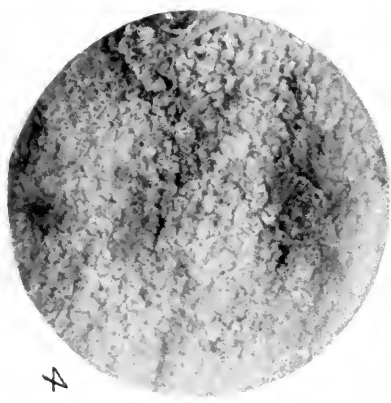
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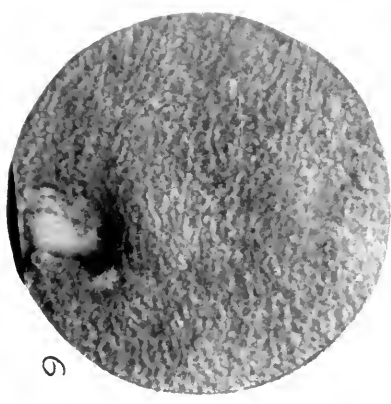
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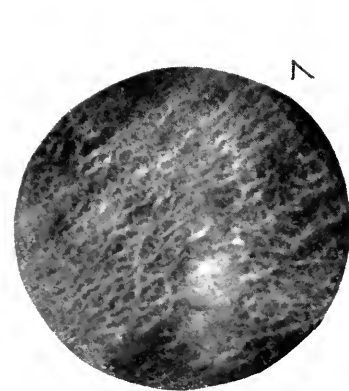


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6

Figs. 1 to 6.



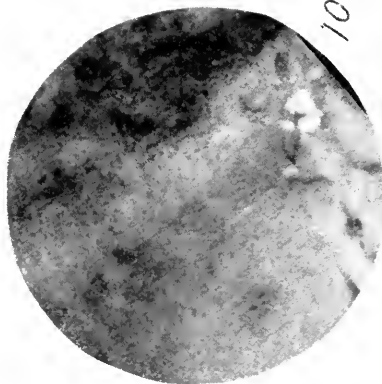
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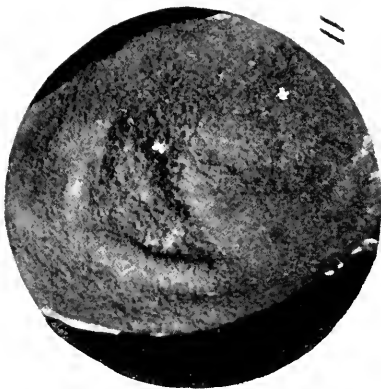
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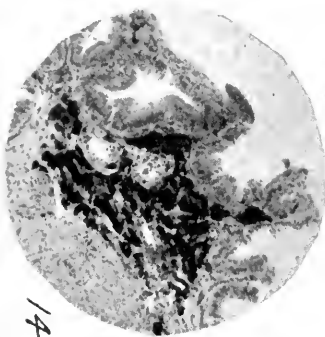
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FIGS. 7 to 12.

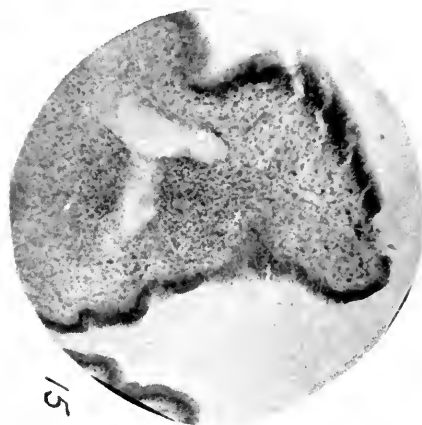




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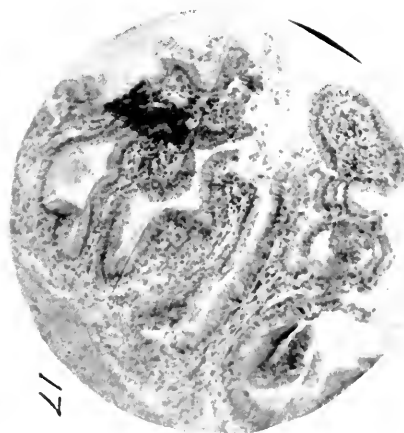
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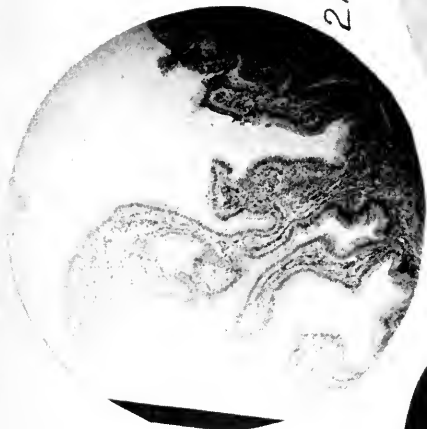


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Figs. 13 to 18.



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22



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FIGS. 19 to 23.

(6) Fibrosis exists in every case, particularly in the tips of the villi. Round cells may be absent as well as polymorphonuclears and lipid, but the constant feature is fibrosis. In many cases where lipid could not be seen on visual inspection nor with the 52-mm. lens, it was noted microscopically in small amounts.

(7) As inflammation changes the villus, there is in addition to the usual accompaniments of inflammation a deposition of lipid, but the greatest change is produced by fibrosis. The villus becomes broader at the base, shorter in long axis, and enlarged at the tip, so as to be almost spherical. This process goes on and in the formation of a papilloma it appears that the base of the villus, or villi, becomes narrowed to a slender filament. This tends to cut off the blood supply which would make conditions favorable for the necrosis of the papilloma and its exfoliation.

The only apparent difference between strawberry and fish-scale papilloma of the gall-bladder is the shape of the yellowish-white masses.

Clinically, the examination of the history of these cases shows no feature distinguishable from features found in forms of chronic catarrhal cholecystitis with lipid deposit. These symptoms include pain more or less definite in the right costal region, at times fever and leucocytosis, occasionally jaundice, belching of gas, nausea, and vomiting, very moderate loss of weight or none at all. Pathologically, it may or may not be found with stones in the gall-bladder or stones of hepatic or common duct or other associated conditions therein.

The purpose of this study is to fix, if possible, the etiological factor in papilloma and to make a pathological classification which will coördinate with the clinical findings, the surgical findings and the pathological findings. MacCarty and Irwin<sup>2</sup> state that "papillomata of the gall-bladder have been seen so frequently in the experience of the writers and have received so little attention in the literature, that it seems advisable at this time to describe and record the condition somewhat in detail, especially since they *belong to the neoplasms*, a group which, as our knowledge increases, is becoming more intimately associated with chronic inflammatory reactions."

We have already stated that the clinical history, the surgical findings, and the post-operative results in papilloma are indistinguishable from those of strawberry gall-bladder and fish-scale gall-bladder. It is apparent to us that these three also differ in no way, except in gross characteristics in a pathological sense. The observations made, warrant the conclusion that papilloma of the gall-bladder, wherever found in the series studied, is not a neoplasm, but is a result and an occasional accompaniment of chronic cholecystitis. From our observations, in this and other studies, it also seems apparent that the scarring and irritating and resultant changes of the mucosa of the gall-bladder produce in order, strawberry appearance, fish-scale appearance, and papilloma appearance of the gall-bladder. Since these are not pathological entities and are part of the same process, it seems more simple to discard these confusing terms and utilize chronic catarrhal cholecystitis

with lipid deposit to designate all three of them, and to restrict papilloma to designate those rare cases where a true neoplasm is present.

An hypothesis is needed to correlate certain clinical, surgical, pathological and post-operative result findings. These findings are:

(1) Certain cases whose clinical history points strongly to disease of the gall-bladder, are productive, on cholecystectomy, of nearly normal specimens in the laboratory of surgical pathology and yet the patients are markedly benefited by the operation.

(2) Clinically, cases of gall-bladder disease show in their course, exacerbations and recessions.

(3) Good clinical results are obtained in the above character of cases by Meltzer Lyon treatment.

(4) Gall-bladders are found having all other characteristics of strawberry, fish-scale and papillomatous appearance, except lipid deposit.

(5) All three of the above appearances, separate or combined, may be noted in limited areas of an otherwise nearly normal gall-bladder mucosa.

Therefore, an hypothesis may be constructed to correlate these facts and to visualize the life history of a gall-bladder the seat of a chronic inflammation as follows: A gall-bladder the seat of chronic inflammation may have one or all three of the above appearances at different times in the course of the disease; as aggression and regression take place the picture changes, and at operation may present any view from a gall-bladder restored to nearly normal, to one the seat of chronic obliterative cholecystitis.

#### EXPLANATION OF FIGURES

Fig. 1.—Nearly normal gall-bladder with mucosa. x 2

Fig. 2.—Strawberry gall-bladder with single mass having papilloma appearance. x 2

Fig. 3.—Fish-scale appearance. x 2

Fig. 4.—Fish-scale appearance without lipid deposit. x 2

Fig. 5.—Nearly normal gall-bladder mucosa with two masses having papilloma appearance. x 2.

Fig. 6.—Definite chronic catarrhal cholecystitis with single papilloma appearance. x 2

Fig. 7.—Definite chronic catarrhal cholecystitis with two papilloma-like masses. x 2

Fig. 8.—Fish-scale appearance without lipid with area of strawberry and single papilloma appearance. x 2

Fig. 9.—Chronic catarrhal cholecystitis with stellate scar of former cholecystostomy and single papilloma appearance. x 2.

Fig. 10.—Approaching cholecystitis obliterans with two papilloma-like masses.

Fig. 11.—From MacCarty and Irwin. "Papillomata of Gall-bladder." x 1

Fig. 12.—Chronic catarrhal cholecystitis with appearance impossible to classify, as strawberry, fish-scale or papilloma, grossly or microscopically. x 2

Fig. 13.—Section nearly normal gall-bladder mucosa. x 10

Fig. 14.—Strawberry gall-bladder. x 10

Fig. 15.—Fish-scale gall-bladder. x 10

Fig. 16.—From MacCarty and Irwin. "Papilloma of Gall-bladder." x 10

Figs. 13, 17, 19, 20, 21, 22, 23, represent in serial form the alteration by inflammation occurring in a villus to transform it from a nearly normal condition to a papilloma-like condition.

## ASEPTIC RESECTION OF INTESTINE

END-TO-END ANASTOMOSIS AND IMMEDIATE RESTORATION OF LUMEN  
BY USE OF SPECIAL APPLICATION OF REMOVABLE  
LOOPED LIGATURE

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IN the ANNALS OF SURGERY, March, 1922, there appeared an article by William Stewart Halsted, M.D., Baltimore, entitled "Blind-end Circular Suture of Intestine, Closed End Abutted and the Double Diaphragm Punctured with a Knife Introduced Per Rectum." The technic suggested is most ingenious and the preliminary report seemed to prove the practicability of the method. This method can, however, be used only upon a limited portion of the lower intestine, since the knife introduced through the rectum to cut the tied-off diaphragm can be introduced but a limited distance. Since the above article appeared I have experimented upon dogs in the Surgical Laboratory of the Los Angeles Post-graduate Medical Department of the University of California, endeavoring to perfect a modification of the Halsted operation enabling it to be performed upon any portion of the intestinal tract. Fifty operations have been performed upon dogs and a definite technic demonstrated to my classes in surgery. On May 1, 1922, the technic was demonstrated before the staff of the Clara Barton Hospital, Los Angeles. The results seem to justify a preliminary report upon a technic for as nearly as possible aseptic resection of any portion of the intestinal tract. This preliminary report is offered as a modification of the Halsted operation with full credit to the article mentioned for suggestions given.

The success of this operation depends upon the proper application of a looped ligature, a single slip knot, of strong linen or silk, holding the ends of the intestine until such a moment as the end-to-end anastomosis is completed, when by a gentle pull this looped ligature is removed, fully opening the lumen of the intestine. Medium-sized Kocher clamps placed with tips at the mesenteric border secure the ligature, tied quite taut with the single loop, until it is ready to be removed, and do much to facilitate easy suture. The entire operation can be carried out quickly with an exact technic and if required without an assistant.

Those who have seen the demonstrations seem enthusiastic over its simplicity and the exactness with which the technic can be performed. In this, as in the Halsted operation, there are left protruding into the lumen of the bowel after the anastomosis is completed rather long margins, inturns, of the cut ends of the intestines. Doctor Halsted points out particularly that these give no trouble and have been taken care of by nature satis-

factorily in the dogs operated upon. In my modification the holding Kocher clamps placed over the retaining looped ligature enables the cautery to burn snug against the clamp without endangering the ligature, thus leaving

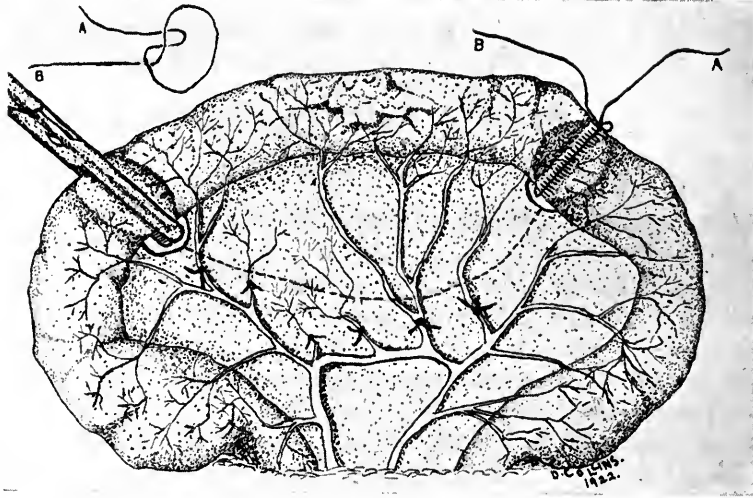


FIG. 1.—At points determined for resection of intestine, the mesenteric border is freed from its attachment for a short distance. A Kocher clamp crushes the intestine at this point and is removed. A looped ligature, as indicated by the insert, is to be tied along the crushed area.

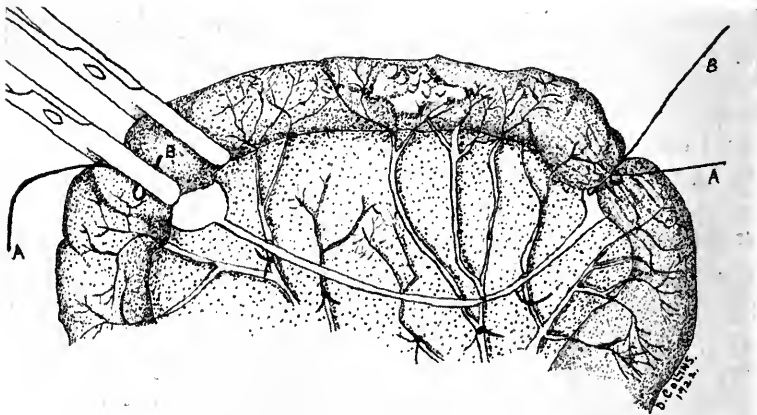


FIG. 2.—Looped ligature of strong linen or silk drawn taut, a Kocher clamp is in place over looped ligature, the loop with its end (A) is left long and protected by the clamp. The end (B) cut short.

a shorter charred margin to be quickly absorbed and less intumescence to be cared for. By the use of this holding clamp no margins have to be trimmed away with scissors, making the act of resection entirely aseptic, and one feels the sense of absolute security against a possible leakage at the cut ends

## ASEPTIC RESECTION OF INTESTINE

while suturing. If the ligature alone is depended upon it could be cut by scissors or cautery with a resulting widespread contamination. With ligatures and clamps in place and the portion desired resected, the ends to be anas-

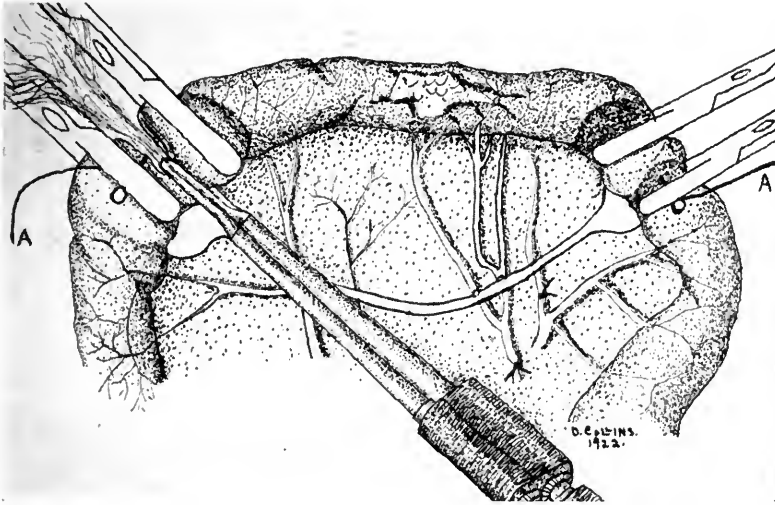


FIG. 3.—Resection between clamps by use of a cautery burning close to clamp.

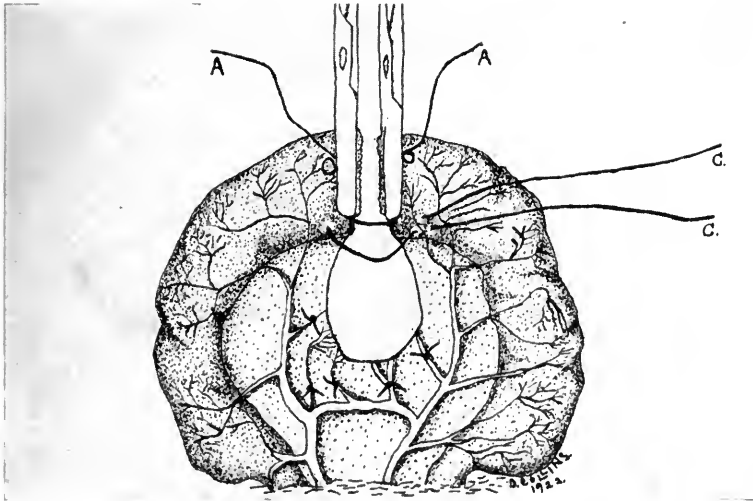


FIG. 4.—Resected portion removed. Ends to be anastomosed are easily abutted and held by the clamps ready for suture. The suture is best started at the mesenteric border and placed to close the mesenteric space as it splits to go about the intestine. This approximates the intestine ends and covers tip of clamps.

tomosed can be abutted easily in all cases, and by holding both clamps and the ends of looped ligatures in one hand the parts are readily kept constantly in the correct position for suturing. All handling of the remaining intestine is thus avoided. The suture should not penetrate the mucosa, can be a continuous or mattress one and is best started at the mesenteric border and

placed so that it closes the space where the mesentery layers split to go about the gut. This row of sutures is placed one-half inch or more from the clamps, enabling the surfaces of the intestine to approximate without tension,

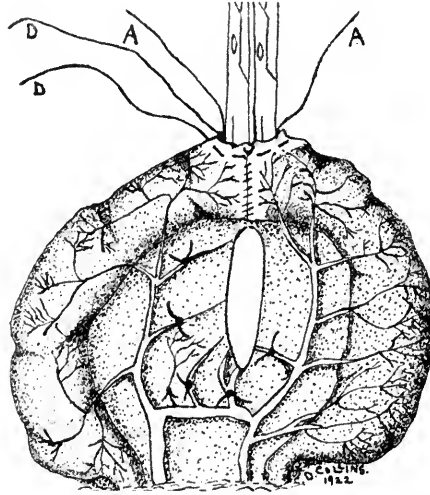


FIG. 5.—The suture is continued until the anastomosis is completed save at the point where the shanks of clamps protrude. A purse-string suture (D) is run about the protruding shanks of clamps. As clamps are removed this purse-string is tightened, closing the anastomosis about the looped ligatures (A) that still protrude.

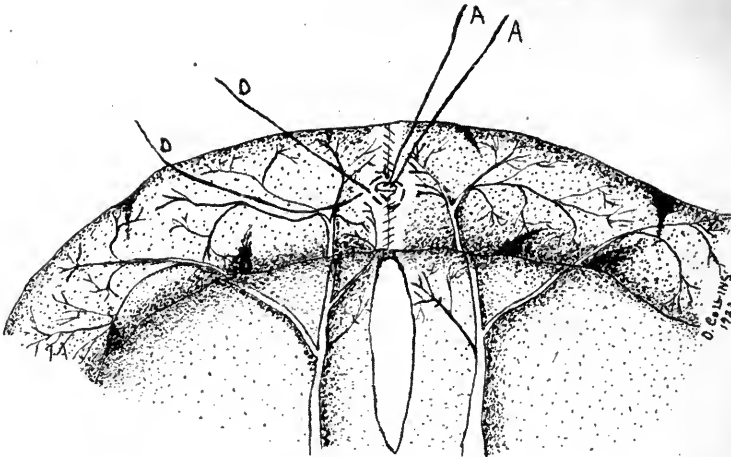


FIG. 6.—Clamps withdrawn. Retaining looped ligatures (A) are still fastened on the ends of intestine preventing any leakage from the bowel; they are withdrawn as the purse-string (D) is tightened, completing the anastomosis.

and is continued to edge of clamp above and tied. The other side of the anastomosis is also sutured up from the mesenteric border in a similar manner. If desired a secondary row of sutures can be placed at this time. A purse-string suture is now run about the portion of the anastomosis where



## ASEPTIC RESECTION OF INTESTINE

the clamps protrude. This is tightened as the clamps are removed until it is snug, but not tight around the protruding ends of the looped ligatures that still hold the cut ends of the intestines. A gentle pull now removes these ligatures and the purse-string is fully tightened, preventing any soiling whatever. Any reinforcing suture can be placed if thought wise. Usually with the clamps and ligatures removed, the edges of the infold do not part at once. The crushing and burning of ends has caused enough of agglutination of parts to still hold the lumen closed, a gentle manipulation opens the lumen and the bowel functions freely.

The larger the lumen of the gut the easier the steps. On the smallest gut of dogs the method can be executed by cutting the gut obliquely from its

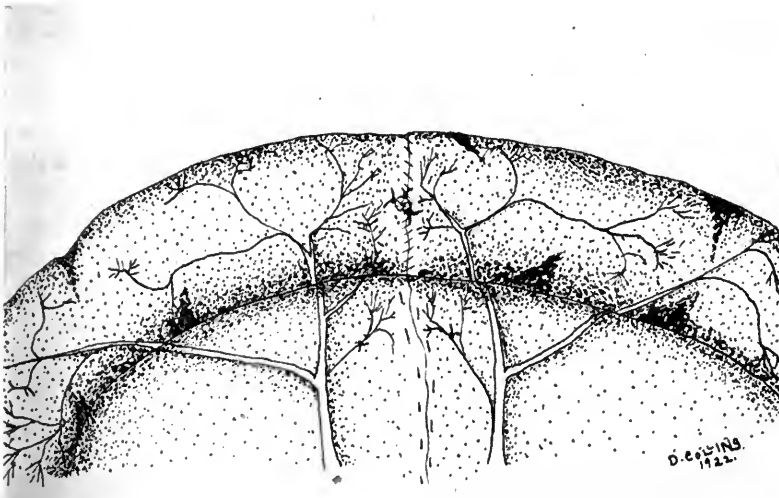


FIG. 7.—Looped ligature (A) withdrawn and anastomosis completed with lumen open for immediate function.

mesenteric border, thus increasing its lumen while preserving its blood supply. A gut of smaller lumen can likewise be cut obliquely, enabling end-to-end anastomosis to a gut of larger lumen. We are using the method upon live subjects and hope to report more fully at an early date. The following cuts illustrate the steps of the operation:

Figure 1. At points determined for resection of intestine, the mesenteric border is freed from its attachment for a short distance. A Kocher clamp crushes the intestine at this point and is removed. A looped ligature, as indicated by the insert, is to be tied along the crushed area.

Figure 2. Looped ligature of strong linen or silk drawn taut, a Kocher clamp is in place over looped ligature, the loop with its end (A) is left long and protected by the clamp. The end (B) cut short.

Figure 3. Resection between clamps by use of a cautery burning close to clamp.

Figure 4. Resected portion removed. Ends to be anastomosed are easily abutted and held by the clamps ready for suture. The suture is best started at the

mesenteric border and placed to close the mesenteric space as it splits to go about the intestine. This approximates the intestine ends and covers tip of clamps.

Figure 5. The suture is continued until the anastomosis is completed save at the point where the shanks of clamps protrude. A purse-string suture (D) is run about the protruding shanks of clamps. As clamps are removed this purse-string is tightened, closing the anastomosis about the looped ligatures (A) that still protrude.

Figure 6. Clamps withdrawn. Retaining looped ligatures (A) are still fastened on the ends of intestine, preventing any leakage from the bowel; they are withdrawn as the purse-string (D) is tightened, completing the anastomosis.

Figure 7. Looped ligature (A) withdrawn and anastomosis completed with lumen open for immediate function.

#### ADVANTAGES IN CONCLUSION

1. The method can be applied to any portion of the intestinal tract except lower rectum, and remove any number of inches or feet.
2. The resection is aseptic, the suturing as nearly so as any non-penetrating suture can be.
3. The suturing is greatly facilitated by the clamps which at the same time guard the looped ligature.
4. No handling of the remaining intestine, through its lumen or externally, is required.
5. Simply withdrawing the looped ligature opens the lumen and enables the bowel to function.
6. The whole operation can be performed with surprising quickness, thus minimizing shock.
7. All of the advantages of an end-to-end anastomosis are gotten without contamination.

## ASEPTIC TECHNIC FOR THE RESECTION OF INTESTINE\*

### BLIND END-TO-END ANASTOMOSIS WITH THE RELEASE OF PURSE-STRING SUTURE AFTER THE ANASTOMOSIS IS COMPLETE

BY CYRUS F. HORINE, M.D.

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IN a review of the literature of intestinal surgery I have found that about two hundred and twenty-five different methods of anastomosis have been devised, of which a score of them have been presented as attempts to do a resection without contamination. Theoretically, this is impossible. If a series of a large number of cases be taken and cultures made from the line of suture, there would be some cultures positive. The underlying principles for doing a gut resection have been very well established, but there is that one problem that still confronts the surgeon in the resection of intestine, namely, infection from the contents of the gut. When the usual methods of resection as the end-to-end and lateral anastomosis are done, the field of operation is exposed to fecal matter, peritonitis may prevent a primary union in the line of suture, resulting in a breaking down of the anastomosis and a development of a fecal fistula. This is especially true in the resection of large intestine where organisms are more virulent and in greater numbers. It is a well-known fact that in the resection of small intestine, where strict technic is observed, peritonitis is less likely to occur where the point of resection is remote to the ileocecal valve.

Figure One. To defeat contamination in the removal of intestine the entire operation must be carried on from without, the moment any instrument is introduced into the lumen of the gut the technic is broken so far as infection is concerned. The proximal and distal portions of gut to the segment to be removed must be isolated from the field of operation. This is done by using a purse-string suture of heavy silk or linen thread. The suture is started at a point distal to the mesentery so that when tied the knot will be above, facing the operator. The suture takes in all the coats of the intestine except the mucous coat. A clamp is now placed on each end of the intestine to be resected, between the two purse-string sutures. The mesentery is taken care of as in any method of resection. The intestine is then divided between the clamp and purse-string suture by electric cauterly and the segment of gut removed.

Figure Two. This diagram shows the way in which the purse-string suture is tied before the gut has been severed with the cauterly. AA is a free hand string of linen thread placed between the gut and the first knot

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\* Read before the Baltimore County Medical Society, April, 1922.

of the purse-string suture. As a way to distinguish this string a knot has been tied in each end.

Figure Three. The knot in the purse-string has been completed, showing AA and BB. BB is the second free-hand string between the first and second knot of the purse-string suture. The rosette of severed gut has been omitted in order to demonstrate clearly the knot. PP are the cut ends of the purse-string suture.

Figure Four. The purse-string suture tied, showing knots with release strings. At this step the segment of gut is ready to be removed.

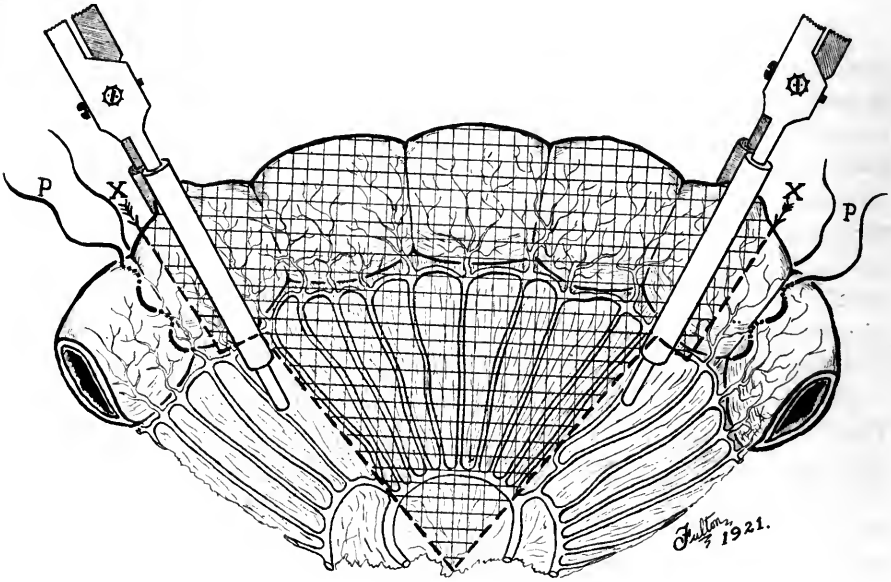


FIG. 1.

Figure Five. The proximal and distal stumps are now brought into apposition and joined together by interrupted mattress sutures of intestinal silk. It is better that this procedure be started at the mesenteric border and continued around the gut on one side to the point distal to the mesenteric attachment, and in the same way on the other side. The diagram is a longitudinal section of gut showing PP' the purse-string suture tied, the release strings being carried out between the mattress sutures. M is the mattress suture which takes in all the coats of intestine except the mucosa. As the release strings are brought out between the mattress, the close approximation of the two ends of the gut is not interfered with to any extent, as very little space is required in doing so, the two surfaces being closed as neatly as though the release strings were not present.

Figure Six. The anastomosis has been completed and a quarter section of gut removed. M demonstrates the tied mattress sutures. The release strings AA' and BB' between the mattress sutures are ready to be released.

ASEPTIC RESECTION OF INTESTINE

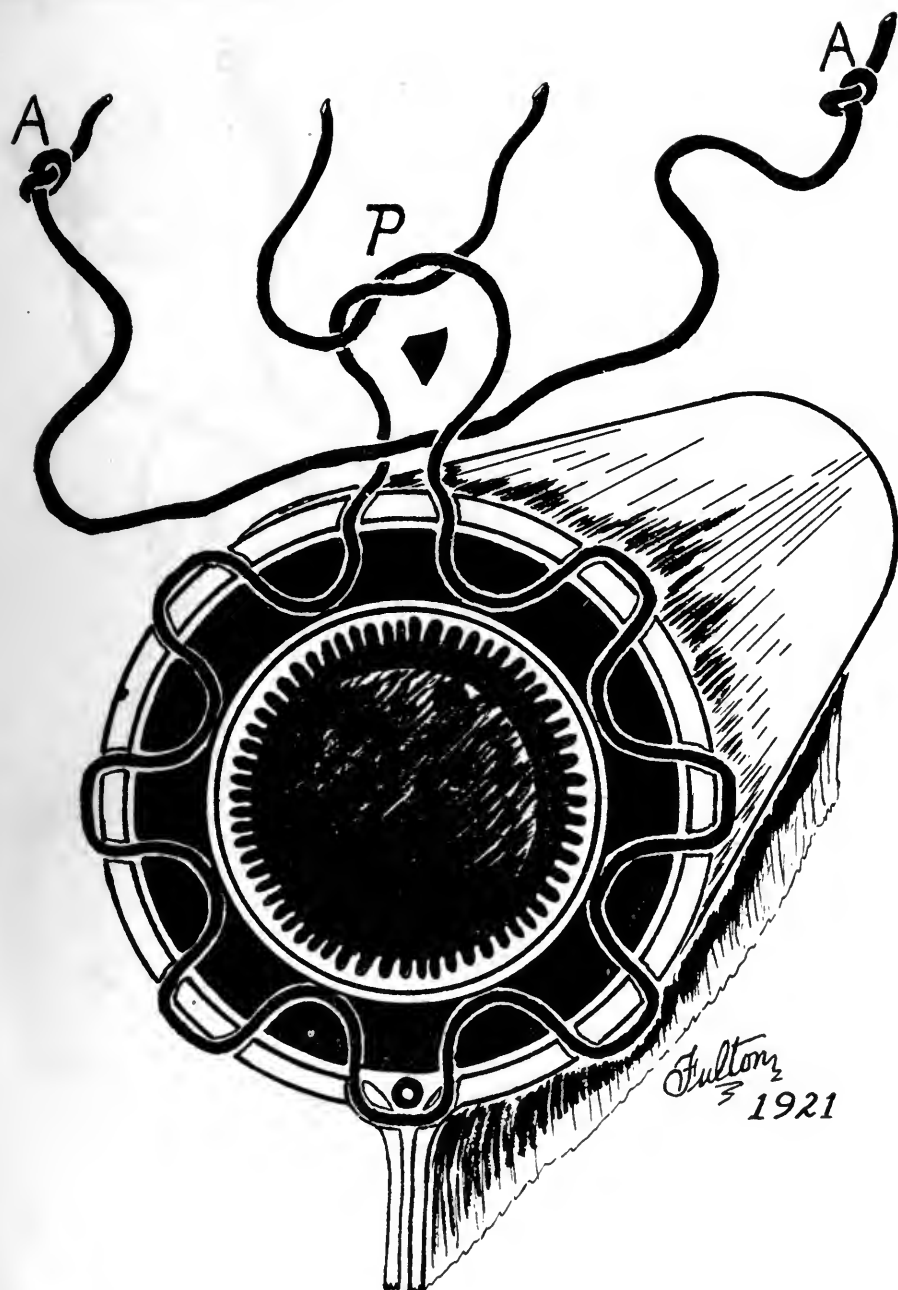


FIG. 2.

Figure Seven. A longitudinal section of the anastomosis showing the release of the knots of the purse-string sutures, allowing the lumen of the

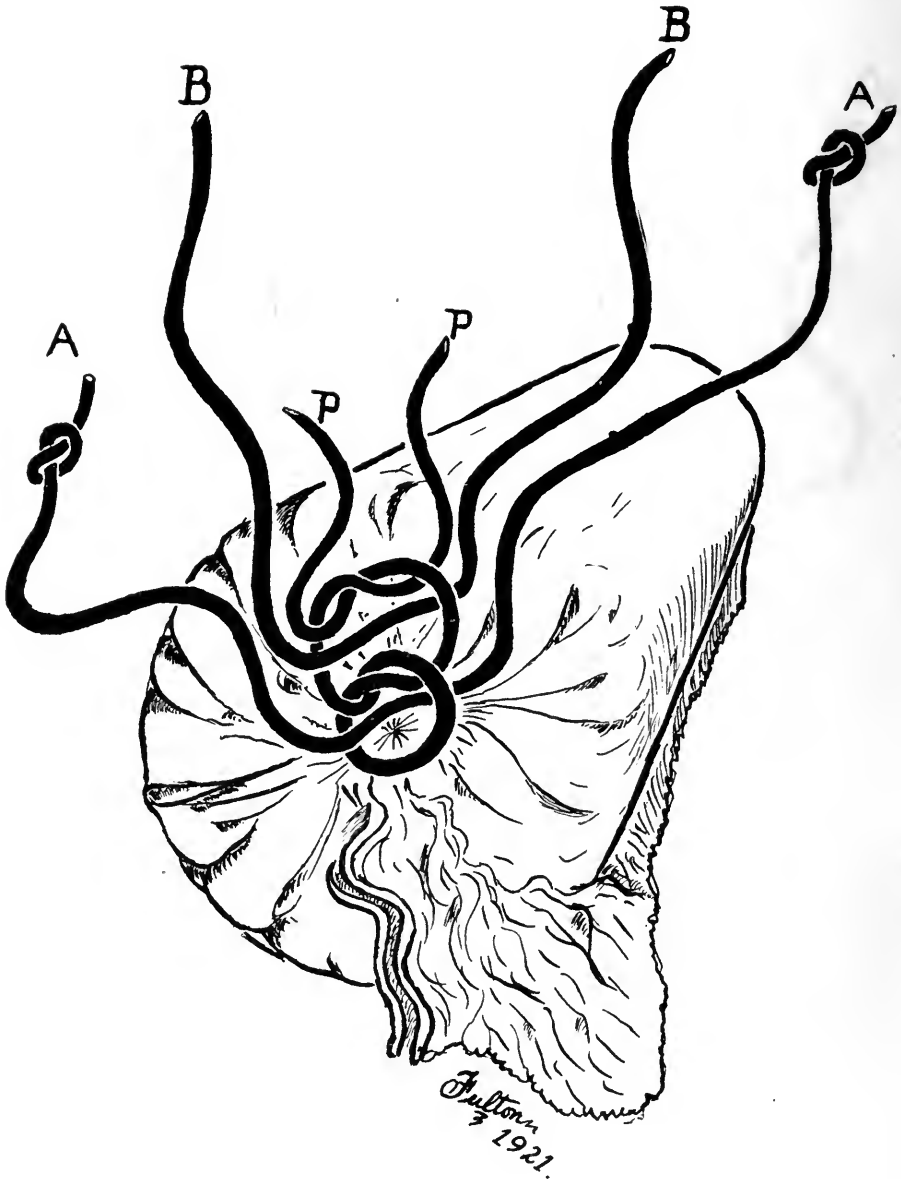


FIG. 3.

gut to be opened after the anastomosis is completed. The arrow indicating the lumen of the gut and the direction of flow of the fecal contents. P the released purse-string suture. Referring again to Figure Four, B and B' are

# ASEPTIC RESECTION OF INTESTINE

the first release strings to be withdrawn. This manœuvre opens the first knot of the purse-string suture. A and A' are then withdrawn allowing the

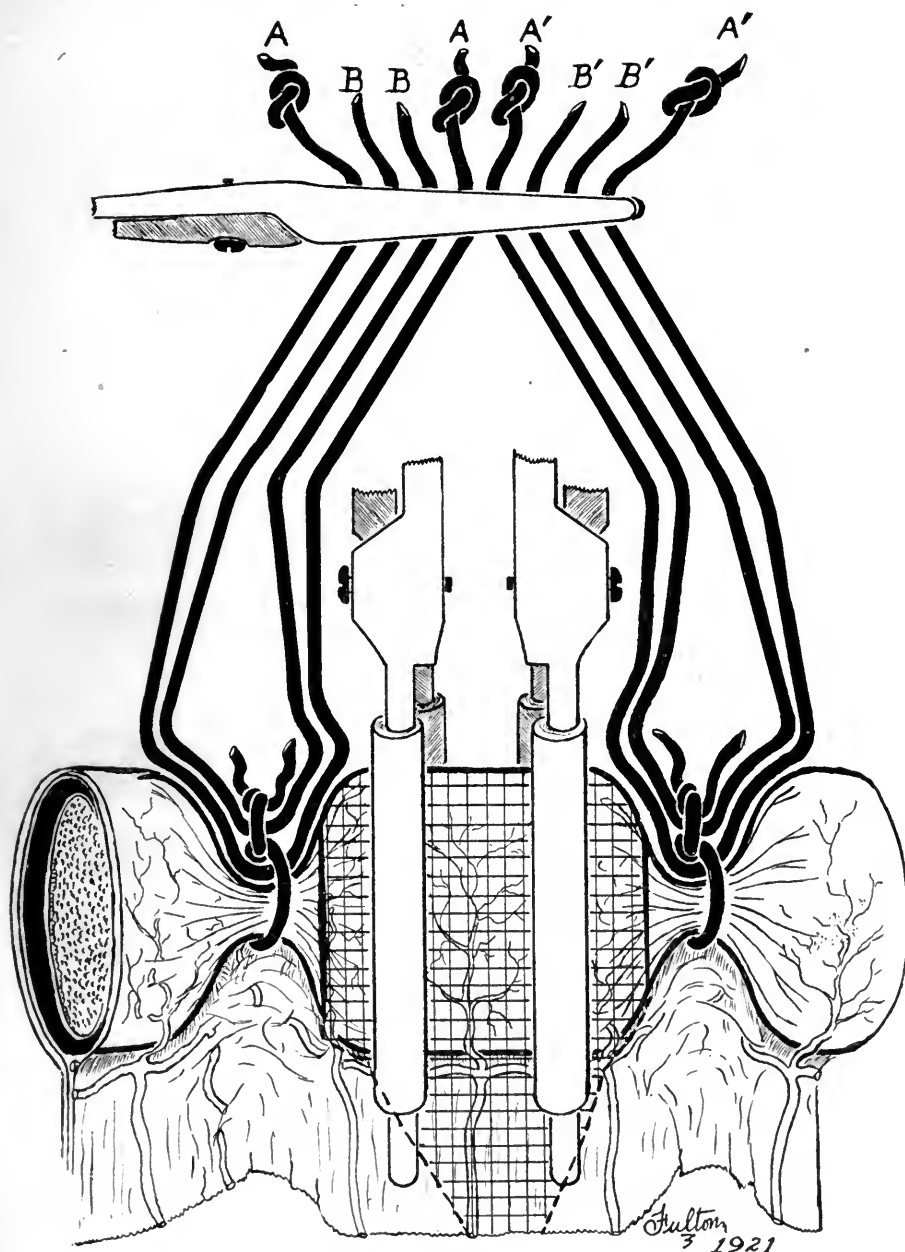


FIG. 4.

purse-string to be opened entirely. By doing this both ends of the gut are opened simultaneously. This prevents one end of released gut contaminating

the knot of the corresponding side. The purse-string suture is allowed to remain in the lumen of the intestine and subsequently passes out with the contents of the gut. L is a continuous suture of intestinal silk, taking in all

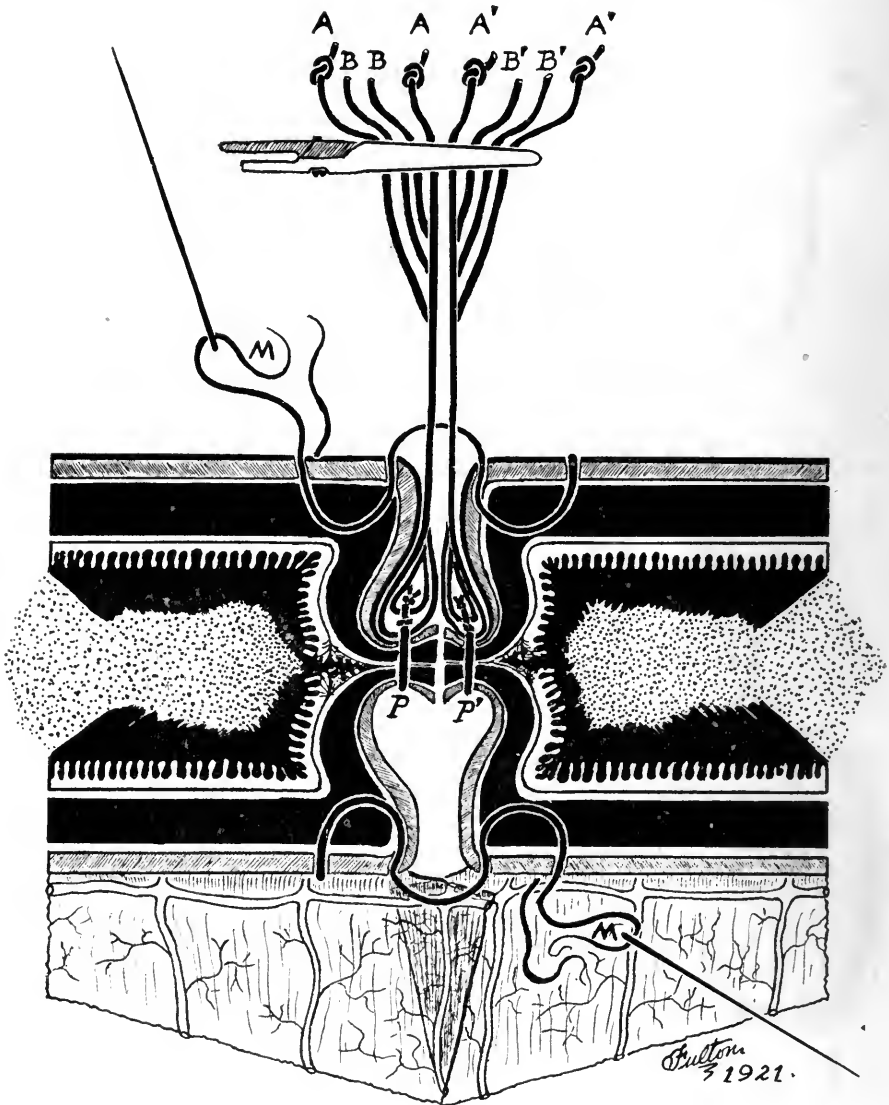


FIG. 5.

the coats of the gut save the mucous coat, which may be used to reinforce the mattress suture. This suture is entirely optional with the operator. The tension produced on the purse-string sutures when tied allows the lumen to open as the knots are broken, but to assure oneself that the lumen has been entirely opened, it is possible to push one end of the gut through the anas-



# ASEPTIC RESECTION OF INTESTINE

tomosis, or, by rotary motion of the anastomosis between the index finger and the thumb.

Figure Eight. Showing the operation completed.

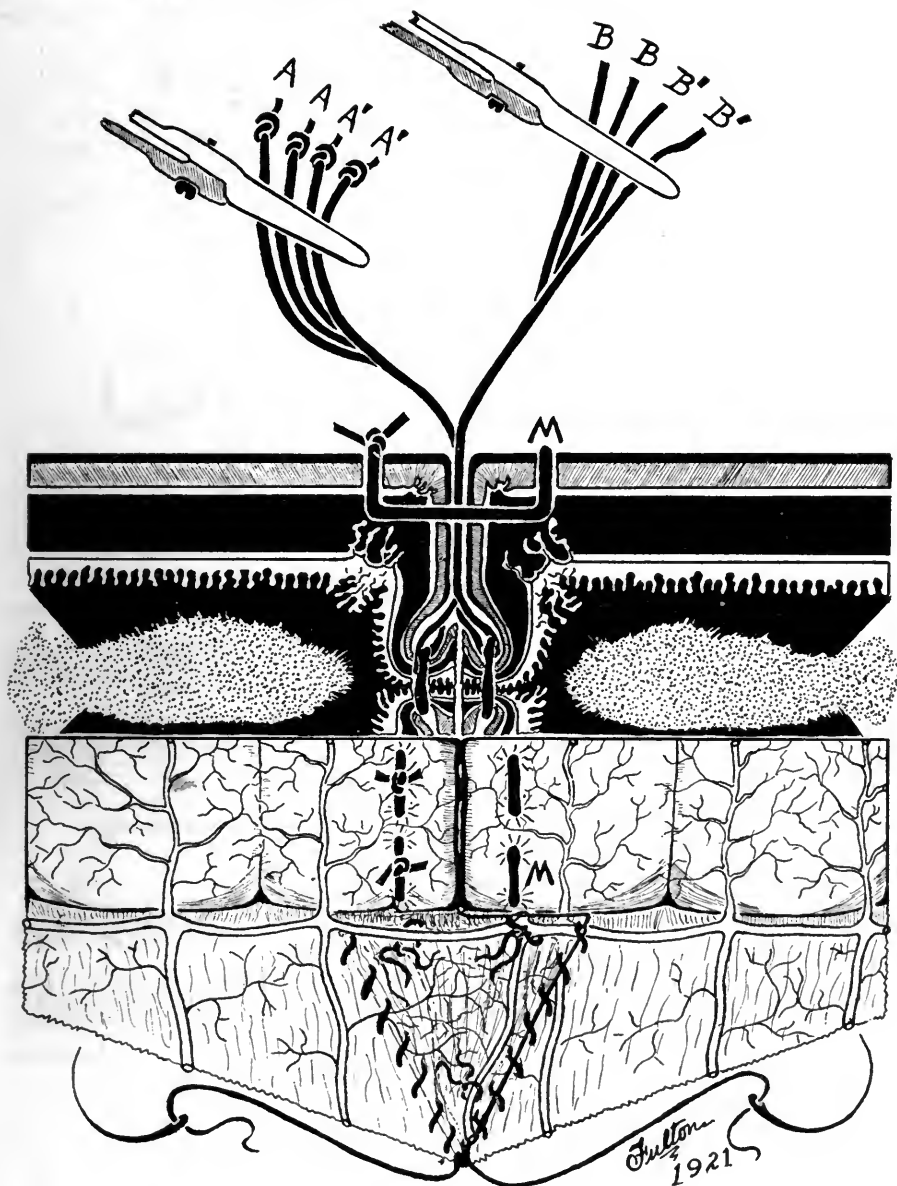


FIG. 6.

This operation has been done on ten dogs without a death and on two occasions has been done on patients. The first patient was operated for an annular carcinoma of the sigmoid, the second having a resection of small intestine about six inches from the ileocaecal valve.

On November 21, 1921, a resection was done on a dog, and it is now nine months up to the time of this writing, and the dog is apparently normal in every respect. Autopsies done on the other dogs at different intervals

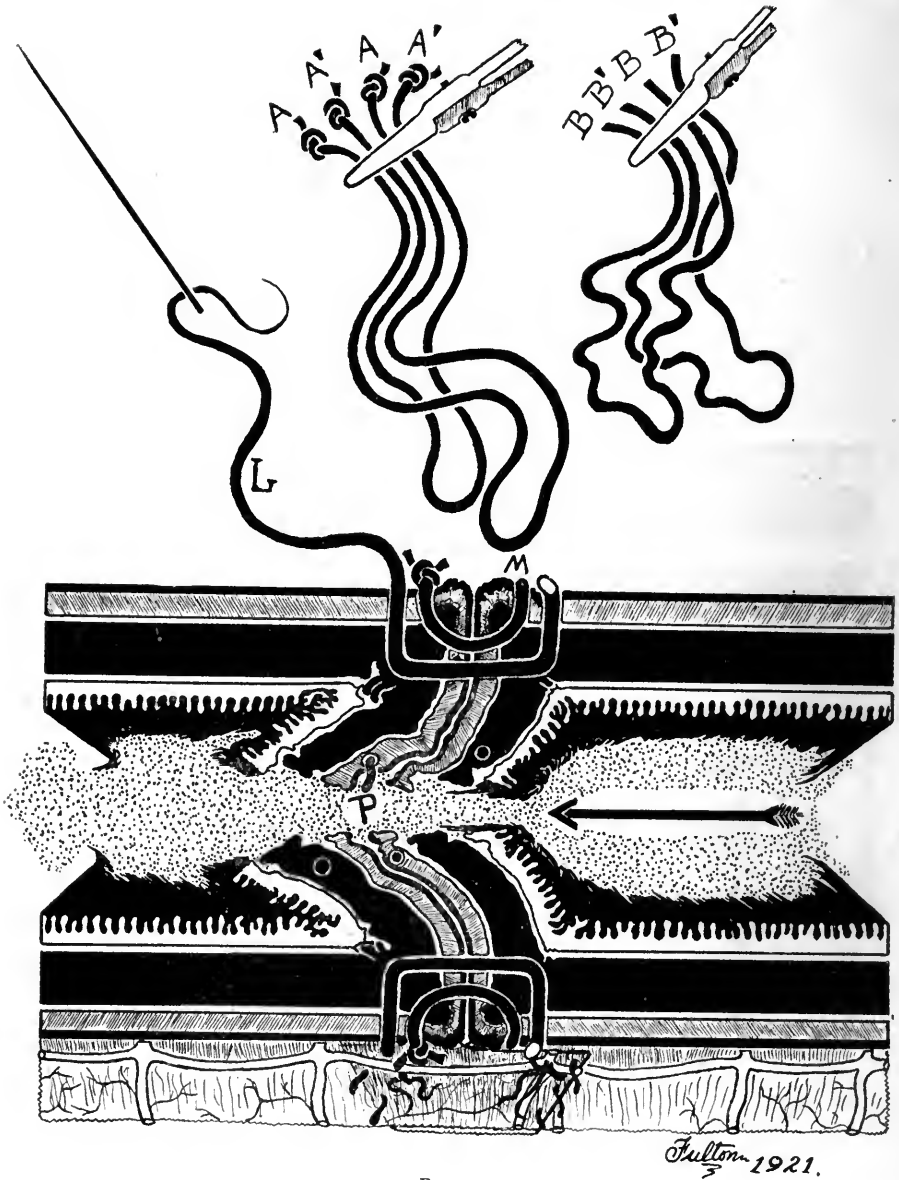


FIG. 7.

after operation showed no signs of leakage or stasis due to constriction at the point of anastomosis, the intum of gut being absorbed between the third and fourth week after operation. The resections were done on all occasions on the large intestine.

In March, 1922, at the Bay View Hospital, I resected an annular carcinoma of the sigmoid on a patient who had had a colostomy previously done. This was not a fair test of the operation as the carcinoma had begun to ulcerate through the gut, and when clamps were applied to remove the section of gut some fecal matter was forced through the ulcerating area and broke the technic of the operation. The patient did well for six days after the operation, but died suddenly on the evening of the sixth day. An autopsy was refused and a definite diagnosis as to the cause of death was not made. Up

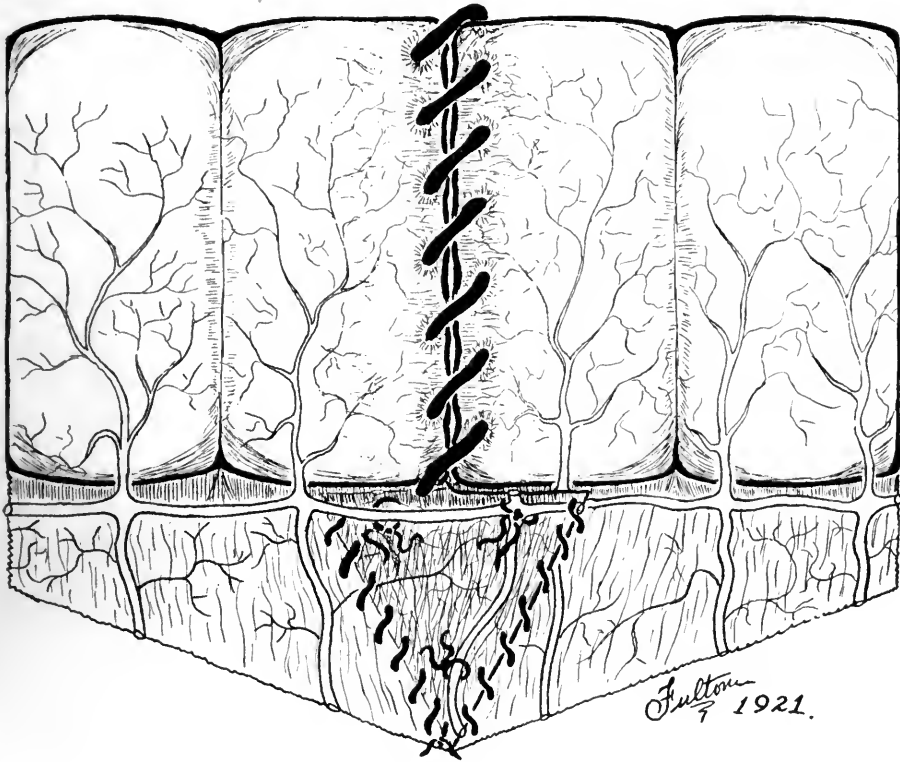


FIG. 8.

until the day of death the patient ran a normal course, pulse and temperature being normal, abdominal rigidity and distention absent. No vomiting or eructation at any time after the operation.

The second patient that I operated using this method was a case of obstruction due to a band. Patient, a colored girl, twenty-two years of age, was operated at the Maryland General Hospital in January, 1919, for bilateral salpingitis. She had an uneventful recovery and was discharged two weeks after operation as cured, wound healing primary. On March 27, 1922, she was admitted to the service of Professor Holland at the University Hospital, with a diagnosis of acute obstruction and was operated upon, using this method. It was necessary to remove about

four inches of intestine. She had a good recovery save for a small pulmonary infarct on the seventh day after operation, from which she recovered without any trouble. Fifth day after operation had a normal voluntary bowel movement. Given soft diet eight days after operation and was discharged from the hospital on the twenty-eighth day as cured. A gastro-intestinal series showed no stasis in the intestinal tract. Four months after operation this patient was again admitted to the service of Professor Holland with another obstruction, which was thought to be due to a stricture in the site of the previous operation. She was operated by Professor Holland, who found several coils of intestine adherent to the abdominal wall, but real obstruction was due to a band involving two loops of intestine. The point of previous anastomosis was several feet beyond the obstruction. There were no adhesions within several feet beyond the obstruction. The lumen of the intestine at the point of anastomosis would easily admit the finger. The peritoneum was studded with many small nodules, thought to be tuberculous, which were not present at the time of operation four months previous.

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## INVOLVEMENT OF THE LYMPH-NODES IN CARCINOMA OF THE RECTUM\*

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THE rectum next to the stomach is the most common location for malignant disease in the gastro-intestinal tract. Mayo reported 561 cases of malignant disease of the gastro-intestinal tract seen in the Mayo Clinic in

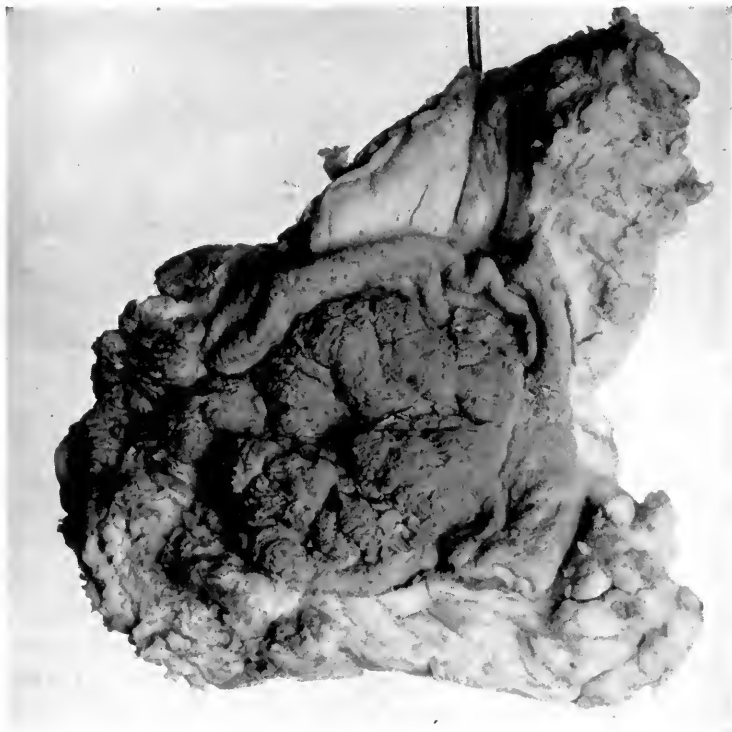


FIG. 1.—(Case A100372). Typical specimen of Group 1.

1908 and 1909. Of these growths, 387 were in the stomach, three were in the small intestine, sixty-nine were in the large intestine, and ninety-two were in the rectum. Gant, Ball, and Halsted assert that rectal cancers make up about 4 per cent. of all the cancers of the body, and that about 80 per cent. of the intestinal cancers occur in the rectum.

Patients with cancer of the rectum are usually in the sixth decade, but

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\* Abstract of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Surgery, May, 1920.

they may be any age. W. J. Mayo, in 120 operative cases, found the average age to be fifty-two years. Oehler, discussing the cases in Kraske's Clinic, says the average age is fifty-six years, slightly higher in males than in females. He quotes Kupferle in Czerney's Clinic who reported a case of rectal carcinoma in a patient aged thirteen years and the Rostocker Clinic as having two cases in patients fourteen and fifteen years, respectively.

The disease is more common in males than in females. In 25,000 cases of disease of the rectum treated for fistula, reported from St. Mark's Hospital by Edwards, 775 were malignant. Five hundred forty-two of the



FIG. 2.—Longitudinal section of the growth shown in Figure 1.

patients were males and 233 were females. In Lynch's 491 cases there were 281 males and 210 females.

The duration of symptoms is usually under one year. Lynch found it to average eight months in 491 cases; in 20 per cent., it was from nine to twelve months.

Various writers fail to agree on the location of the growths. Cole gives the favorite site as the anterior and lateral walls; Rawling believes that the posterior wall is most often affected, and Oehler says that they occur as often on the anterior as on the posterior wall. Edwards asserts that about 80 per cent. of the growths occur 5 to 7.5 cm. from the anus; Gant, in 100 cases, found 50 per cent. in the ampulla and 15 per cent. in the upper rectum and sigmoid, while W. J. Mayo, in 100 consecutive cases, found 63 per cent. in the rectosigmoid, 30 per cent. in the rectum, and 7 per cent. in the anal canal. Mummery believes the commonest site is the rectosigmoid, and next the ampulla. He believes that those who say the growths occur at a lower level do not take into account the fact that they may descend after starting.

The usual type of growth is adenocarcinoma. In Lynch's 491 cases, 451 were adenocarcinomas. Of Gant's 100 cases, 95 per cent. were cylindric carcinomas, and in three-fourths of the cases studied by Oehler the growths were of the type which he calls adenocarcinoma simplex. In view of the various classifications which have been given to carcinomas of the rectum,

some based on clinical grounds, others on histologic grounds, and still others developed from a combination of both, it seems best not to attempt any classification other than carcinoma.

Carcinoma of the rectum develops from the crypts or glands of Lieberkuhn which, when they take on their migratory activities, break through the tunica propria of the mucosa into the submucosa, invade the circular muscular coat and, on reaching the intermuscular lymphatic network, tend, according

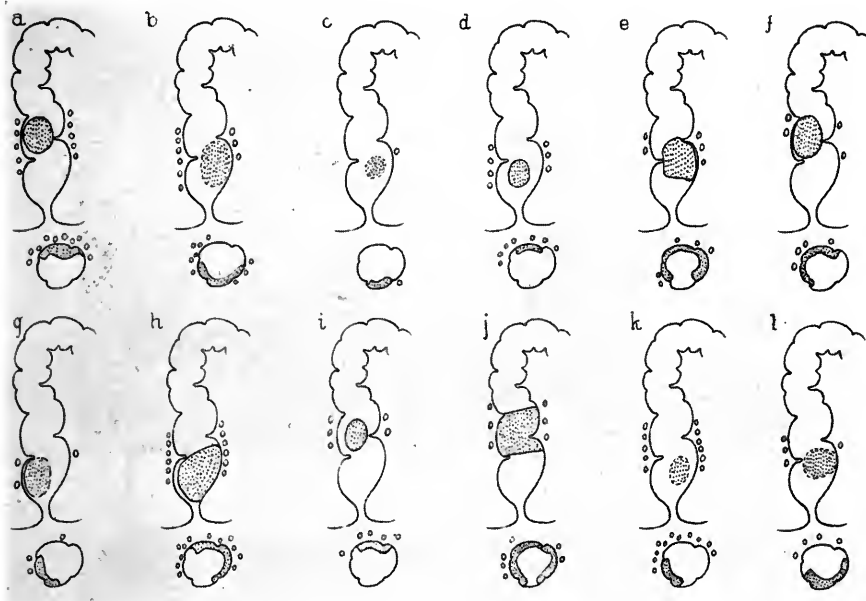


FIG. 3.—Diagram of relative position of glands and growth in twelve cases of Group 1. Glands not involved are shown as clear circles; glands involved are shown in solid black. *a* (Case A47322). Growth measuring 50 by 50 mm.; 10 cm. from anus. *b* (Case A57201). Growth on anterior wall measuring 50 by 70 mm.; 5 cm. from anus. *c* (Case A68756). Growth on anterior wall measuring 15 by 20 mm.; 5 cm. from anus. *d* (Case A70580). Growth on posterior wall measuring 25 by 33 mm.; 3 cm. from anus. *e* (Case A70730). Growth on posterior wall measuring 45 by 45 mm.; 6 cm. from anus. *f* (Case A81871). Growth on left and posterior wall measuring 40 by 50 mm.; 10 cm. from anus. *g* (Case A97023). Growth on anterior and left wall measuring 30 by 35 mm.; 3 cm. from anus. *h* (Case A100372). Growth on posterior and right wall measuring 50 by 70 mm.; 2 cm. from anus. *i* (Case A102528). Growth on posterior wall measuring 30 by 35 mm.; 10 cm. from anus. *j* (Case A103155). Encircling growth measuring 70 by 70 mm.; 10 cm. from anus. *k* (Case A104886). Growth on left and anterior wall measuring 20 by 25 mm.; 4 cm. from anus. *l* (Case 107782). Growth on anterior wall measuring 60 by 35 mm.; 4 cm. from anus.

to Cole, to progress around the bowel in the direction of these vessels. This accounts for the encircling tendency of rectal carcinoma. From here the cells invade the longitudinal muscle layer and on reaching the outer muscle wall their extension is restricted by the rectal fascia. The invasion of the lymph-nodes through the lymphatics may occur at any time after the disease reaches the submucosa, but such invasion is usually late. W. J. Mayo says that more cases are inoperable because of local extension than because of metastasis. Three methods of extension are described by Miles: Downward into the wall of the bowel below the growth, into the rectal sphincter, and ischiorectal fossa; lateralward into the fascia propria, levator ani muscles, capsule of the prostate, seminal vesicles, and base of the bladder in the male, and the vaginal

wall and genital organs in the female, and upward into the bowel above the growth, and the pelvic peritoneum and mesocolon. Handley has described a marked dissemination in the submucosa occurring early. This he claimed

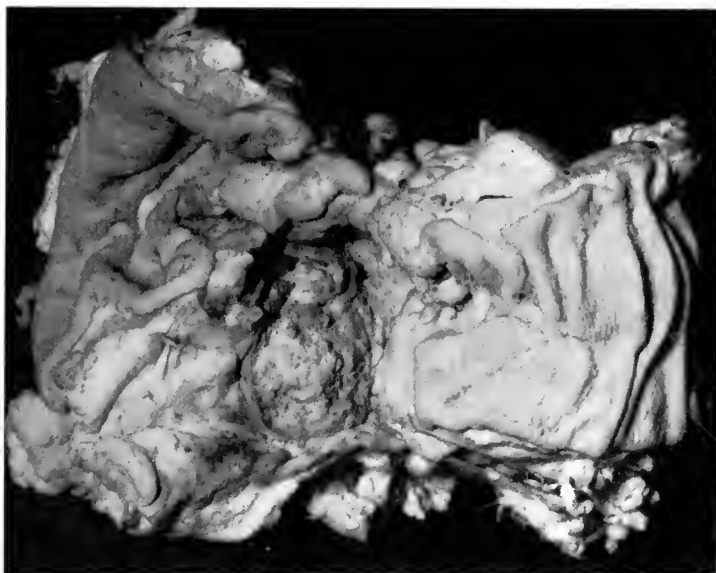


FIG. 4.—(Case A176669.) Typical specimen of Group 2.

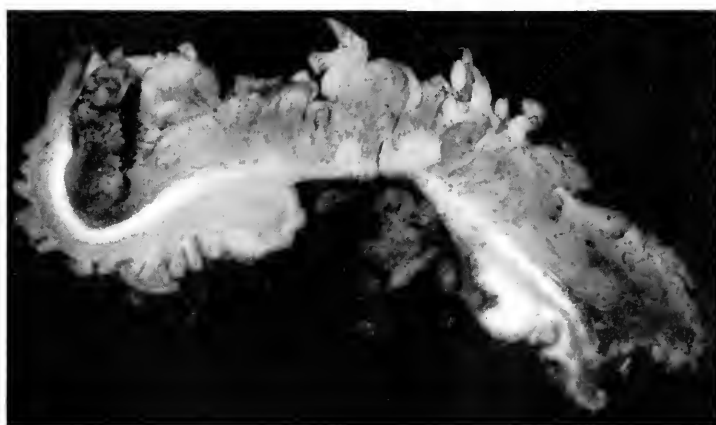


FIG. 5.—Longitudinal section of the growth shown in Figure 4.

to have demonstrated by mucicarmin staining of entire sections of the bowel. Cole, Monsarrat and Williams, and Cheatle were unable to confirm his findings.

Cancer of the rectum metastasizes slowly in most cases. Oehler had fifty-eight patients die from carcinoma of the rectum and thirty-four had no internal metastasis. Zinner found metastatic enlargement of retroperitoneal



lymph-nodes in only 3.5 per cent. of the 141 patients examined. Pennington collected data on 997 necropsies of patients dying from cancer of the rectum and in 324 the regional nodes were found to be involved. Metastasis, when it does occur, usually takes place in the liver. Oehler says that metastasis is most frequent in the liver and retroperitoneal lymph-nodes and that the lungs are seldom involved, and the remaining organs still more seldom. Rectal carcinoma may reach the liver through glandular metastasis or by the breaking off of emboli of carcinoma cells into the portal circulation, a method recognized and described by W. J. Mayo, McArthur, Smith, and others.

*Materials and Methods.*—One hundred specimens were studied which had been removed at operation at the Mayo Clinic. The size, location, form, extent, and character of the growth were studied as well as the normal mucosa, skin, surrounding fat, and fascia. Photographs were then made of the specimens, one showing the growth from the mucosal side, and one showing a cross-section cut through the centre of the growth in the longitudinal axis of the bowel. The character and extent of the invasion of the growth into the sub-mucosa, muscular coats, glands, fat, and fascia were studied and sketches of the specimens were made, showing the relative location and size of the growth recorded in millimetres.

The anorectal lymph-nodes were then carefully dissected out, and as each gland was removed its location in the longitudinal and radial directions was recorded on the sketch. The glands were then placed in small phials correspondingly numbered and preserved in formalin. A section of the original growth was also made and similarly preserved. Frozen sections averaging about 10 microns in thickness were made of each gland and these were stained in hæmatoxylin and eosin and mounted in balsam.

The sections of the glands were studied for metastasis. On the sketches the results of the microscopic examinations were recorded for each gland with appropriate notes of any striking features.

The results were then recorded on printed diagrams. The diagrams were

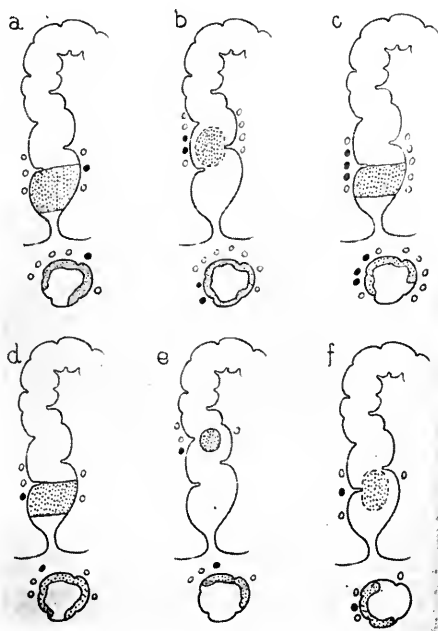


FIG. 6.—Diagram showing relative position of glands and growth in six cases of Group 2. Glands not involved are shown as clear circles; glands involved are shown in solid black. *a* (Case A174591). Growth on anterior wall measuring 95 by 60 mm.; 3 cm. from anus. *b* (Case A176669). Encircling growth measuring 50 by 60 mm.; 6 cm. from anus. *c* (Case A185201). Encircling growth measuring 45 by 40 mm.; 7 cm. from anus. *d* (Case A187873). Encircling growth measuring 80 by 55 mm.; 3 cm. from anus. *e* (Case A201505). Growth on posterior wall measuring 20 by 20 mm.; 12 cm. from anus. *f* (A250973). Growth on left wall measuring 50 by 50 mm.; 9 cm. from anus.

made to represent the sigmoid, rectum, and anus as viewed posteriorly and also the rectum in cross-section. The growth was sketched in its relative position and the lymph-nodes were placed as near as possible in the relative position in which they were found. Glands which showed no carcinomatous involvement on microscopic examination were represented as clear circles, while those showing metastatic involvement were represented in solid black. The variation in the size of the glands is not indicated in the diagram.

*Results.*—Forty-seven per cent. of the patients were in the sixth decade and 96 per cent. were between thirty-one and seventy years (Table I). The average age was fifty and eighty-eight hundredths years. The youngest were two patients twenty-nine years and the oldest was seventy-nine. There were

fifty-seven males and forty-three females. The average duration of symptoms was ten and four-tenths months.

Six hundred and twenty-three glands were obtained from the 100 specimens, or an average of six and twenty-three hundredths glands for each specimen. Fifty-three per cent. of the specimens did not show glandular involvement, 30 per cent. showed slight glandular involvement, and 17 per cent. showed marked glandular involvement. The cases may be readily classified into three groups: Group 1, cases of carcinoma of the rectum without metastatic involvement of the regional lymph-nodes.

Group 2, cases of carcinoma of the rectum with metastatic involvement of less

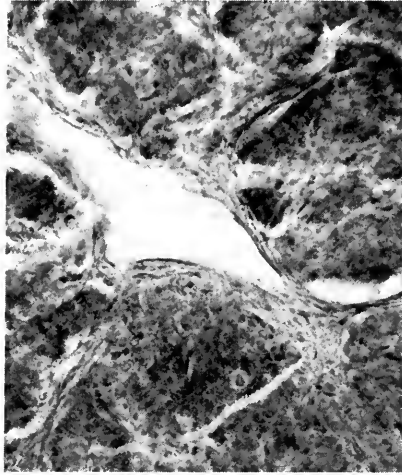


FIG. 7.—(Case A80564.) Metastasis in anorectal lymph-node. Cells show first degree of cytodifferentiation (X100).

than one-half of the regional lymph-nodes, and Group 3, cases of carcinoma of the rectum with involvement of one-half or more of the regional lymph-nodes.

*Group 1.*—This group contained fifty-three patients (53 per cent.). Thirty were males and twenty-three were females. The average age was fifty-one and six-tenths years. The average number of glands for each specimen was six and nine-hundredths (Table II).

One of the most striking features is that the size of the growth (Figs. 1 and 2) apparently bears no relation to the extent of glandular involvement (Fig. 3). Most of the growths in this series were above the average in size and caused symptoms of equal or longer duration than the average for the series. Most were protuberant and appeared to be growing into the lumen of the bowel rather than into the bowel wall, as is seen in the cross-section of the growth. Little attempt at direct extension into the muscle and fatty layers is seen. The glands vary in size; many were much larger than those in the other groups, so that no attempt was made to demonstrate the relative size of the glands on the diagrams.

## THE LYMPH-NODES IN CARCINOMA OF RECTUM

*Group 2.*—There were thirty patients (30 per cent.) in this group. Seventeen were males and thirteen were females. The average age was forty-eight and six-tenths years and the average duration of symptoms was eleven and

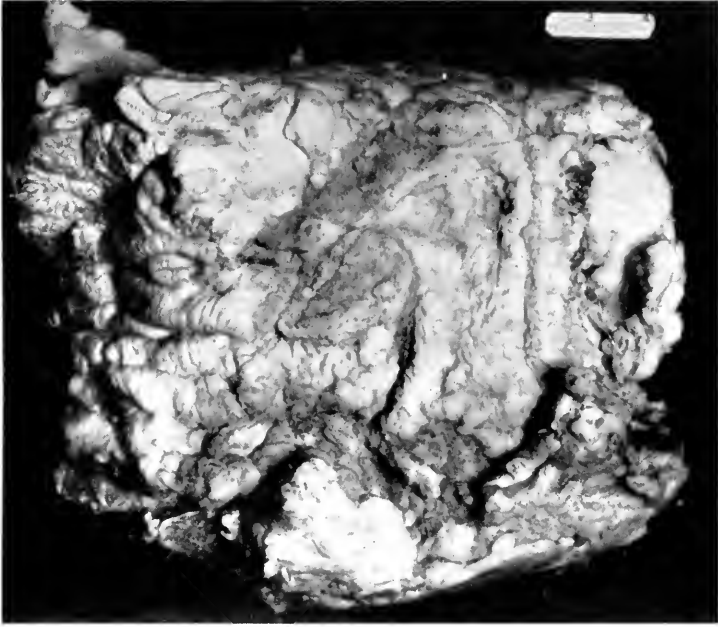


FIG. 8.—(Case A121346.) Typical specimen of Group 3.

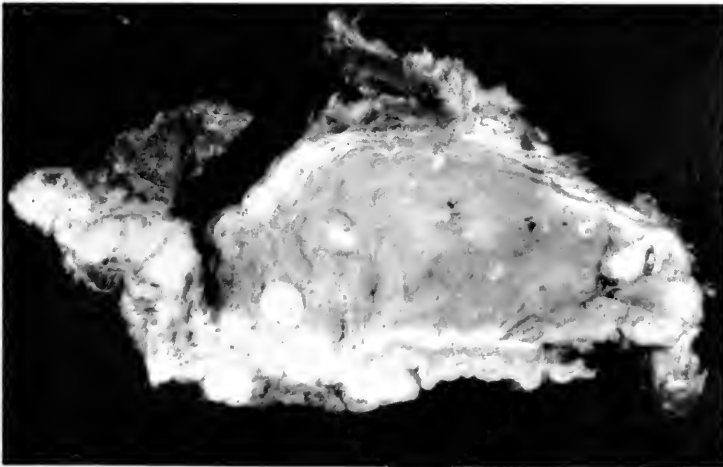


FIG. 9.—Longitudinal section of growth shown in Figure 8.

one-tenth months. The average number of glands for each specimen was six and five-tenths. The sex, age, duration of symptoms, number of glands found, and number of glands involved in each specimen are shown in Table III.

The photographs of this group (Figs. 4 and 5) also show that the size of the growth bears no direct relation to the amount of glandular involvement (Fig. 6). The protuberant type of growth occurred less often; most of the growths showed excavated ulcers. The growths showed a tendency to grow into the muscular tissue and the fatty tissue around the bowel wall, and thus to disseminate by direct extension. The gland or glands usually involved are those nearest the point of greatest direct extension. In other

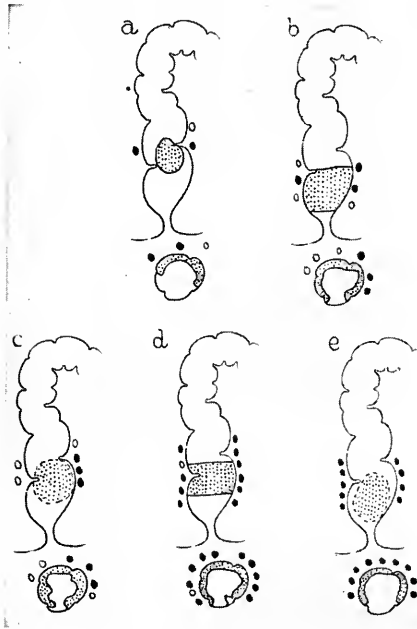


FIG. 10.—Diagram showing relative position of glands and growth in five cases of Group 3. Glands not involved are shown as clear circles; glands involved are shown in solid black. *a* (Case A110220). Encircling growth measuring 40 by 30 mm.; 9 cm. from anus. *b* (Case A121346). Encircling growth measuring 70 by 50 mm.; 5 cm. from anus. *c* (Case A139873). Growth on anterior wall measuring 80 by 60 mm.; 7 cm. from anus. *d* (Case A168690). Encircling growth measuring 55 by 60 mm.; 7 cm. from anus. *e* (Case A217336). Growth on anterior wall measuring 35 by 40 mm.; 3 cm. from anus.

words, the metastasis is slow and the microscopic pictures show that the majority of the cells in most of the affected nodes, as seen in Figure 7, reach the state of secondary cyto-differentiation.<sup>11</sup> In many of the involved glands the cells are arranged in acinar form and in some this differentiation is advanced to the point of mucous production. This can only happen if the migration of the cells is slow and the tendency to return to the original type is strong.

*Group 3.*—There were seventeen patients (17 per cent.) in this group. Ten were males and seven were females. This is about the average for the entire series, so that sex apparently does not play a part in determining malignancy. The average age was fifty-one and two-tenths years and this also seems to show that the age does not determine malignancy to any great extent. It is true in carcinoma of the rectum as in all carcinomas in the body, that the most malignant types of growth

occur in very young persons. The average duration of symptoms was seven and four-tenths months, which is almost four months less than the average for the other groups. While this group is too small for definite conclusions to be drawn, it would seem to show that in the more rapidly growing types the symptoms are such as to cause patients to seek medical advice earlier. The average number of glands for each specimen was six and one-tenth. Table IV gives the sex, age, duration of symptoms, total number of glands found and total number of glands involved for each specimen in the group.

The characteristic type of growth in Group 3 is seen to be the ulcerative (Figs. 8 and 9) and most of the growths were much smaller than the average of Group 1. The specimens (Fig. 9) resembled the growths in Group 2 in breaking through the muscular coats of the bowel, but their dissemination

into the fatty tissue surrounding the bowel was much less. Metastasis occurs early to the nodes (Figs. 10 and 11) before direct extension far into the surrounding tissues has taken place.

Early glandular involvement affects so small a part of the gland that it can only be ascertained by microscopic examination. The lymph sinuses at the edge of the gland are first affected (Fig. 12).

Smith says, "There is need for further investigation on this subject (speaking of glandular involvement in carcinoma of the rectum), but I think sections of all glands from a series of rectal growths would prove that

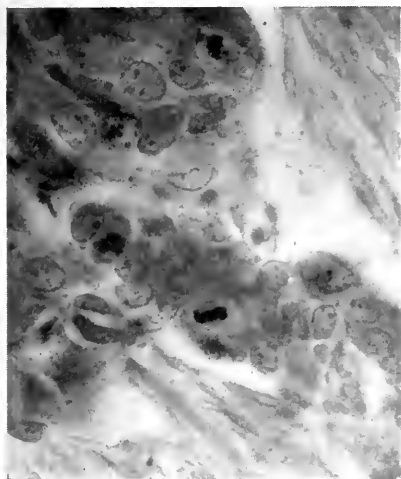


FIG. 11.—(Case A85834.) Metastasis in lymph-node. First degree of cytodifferentiation. Cells have large, clear nuclei with prominent nucleoli; two mitotic figures may be seen (X500).

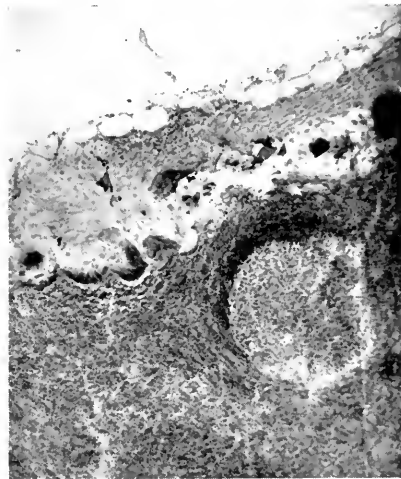


FIG. 12.—(Case A110220). Beginning involvement in peripheral lymph sinus, which could be determined by microscopic examination only (X50).

glandular invasion is not widespread in the stages early enough to be operable." This statement, based on clinical experience, is partially borne out by this study. Fifty-three per cent. of the patients did not have involvement of the glands, 30 per cent. had partial involvement, and 17 per cent. had marked involvement. Oehler reports that 38 per cent. of the fifty-four patients who died from carcinoma of the rectum and on whom necropsies were performed had glandular involvement in the retroperitoneal lymph-nodes. In Pennington's collected cases, 32 per cent. showed some involvement of the regional lymph-nodes. In neither instance was it stated that all the nodes were systematically examined. MacCarty and Blackford found 52 per cent. of 200 patients with carcinoma of the stomach to have glandular involvement. The close agreement of their percentages for the stomach and of those presented in this paper for the rectum is striking. It may mean that about one-half of the growths of the gastro-intestinal tract give rise to metastatic glandular involvement.

A systematic examination of the glands affords a more accurate idea of the prognosis in a given case. In studying the glands in Case A80564 (Fig. 7), the following note was made: Sections show but little evidence of differen-

tiation; the tumor should be rapidly growing. One should expect a short history and a poor result. When the history of the patient was consulted later, it was found that the symptoms had been present only six weeks. Operation was performed by the Mayo-Kraske method and the growth entirely removed. The patient returned to the Clinic six months later, and it was found that the disease had metastasized to the liver. He died shortly afterwards. The question of operability is often clinical, but the question of prognosis, aside from operative prognosis, is one which can only be accurately and safely answered by the aid of the microscope.

TABLE I  
*Distribution in Decades of the 100 Cases of Carcinoma of the Rectum*

Age		Patients
21 to 30 years	(29, 29, 30) .....	3
31 to 40 years	.....	12
41 to 50 years	.....	22
51 to 60 years	.....	47
61 to 70 years	.....	15
71 to 80 years	(79).....	1
Total	.....	100

TABLE II  
*Group I. Cases of Carcinoma of the Rectum Without Metastatic Involvement of the Lymph-nodes*

Case	Sex	Age	Duration of symptoms, months	Glands dissected out	Case	Sex	Age	Duration of symptoms, months	Glands dissected out
669-½J	F	50	(?)	6	A120405	F	47	12	10
A2252	F	53	5	2	A121876	M	54	15	6
A3663	F	34	11	2	A123863	F	61	12	10
A7676	F	46	6	10	A124529	M	55	24	11
A7769	M	42	4	8	A132394	M	55	18	4
A8928	F	41	3	6	A136043	M	69	24	7
A715	F	58	12	5	A138027	F	51	4	3
A1484	F	53	36	5	A142982	F	47	36	1
A6354	F	54	8	3	A147264	F	67	3	2
A25364	F	61	12	2	A148799	M	69	5	11
A26283	F	70	(?)	6	A154180	M	34	12	4
A43441	F	57	12	9	A157347	M	54	12	7
A47322	F	53	18	10	A163565	M	43	24	10
A57201	F	51	10	9	A170796	M	57	8	4
A68756	M	51	12	1	A179420	M	48	36	9
A70580	F	56	3	7	A189827	M	55	11	7
A70730	M	53	12	5	A198743	F	53	3	4
A81871	M	52	7	4	A200441	F	38	5	6
A97023	M	60	18	3	A204879	M	57	13	9
A100372	M	50	12	12	A208438	M	44	3	5
A102258	M	45	6	5	A212669	F	40	24	5
A103155	M	64	12	6	A216300	M	39	9	4
A104886	M	46	8	11	A216842	M	43	7	7
A107782	M	44	4	4	A215439	M	51	12	4
A111786	M	50	12	10	A251281	M	54	3	5
A113133	F	51	12	9	A250263	M	54	7	2
A113219	M	53	12	6					

# THE LYMPH-NODES IN CARCINOMA OF RECTUM

TABLE III

Group 2. Cases of Carcinoma of the Rectum With Metastatic Involvement of Less Than One-half of the Lymph-nodes

Case	Sex	Age	Duration of symptoms, months	Glands dissected out	Glands involved
A19499	M	36	3	3	1
A26781	F	52	7	3	1
A43021	F	30	12	7	2
A44196	M	66	2	9	1
A47912	M	39	12	7	1
A64157	M	29	36	5	1
A66903	F	53	10	7	1
A69046	M	59	9	8	2
A73143	F	68	3	9	2
A79532	M	48	24	7	1
A80562	M	56	1.5	8	1
A99562	F	45	6	5	2
A101064	F	53	9	5	2
A109751	F	59	10	7	1
A159369	F	38	24	8	1
A164471	F	58	18	8	3
A166175	M	50	2	7	2
A168277	F	52	5 (?)	5	2
A169130	M	58	12	11	3
A169140	F	56	24	6	1
A174098	M	42	18	7	1
A174591	M	60	12	6	1
A176669	M	51	12	9	2
A185201	F	40	12	10	3
A187873	M	59	9	5	1
A201505	F	51	12	4	1
A250973	M	79	3	4	1
A2360	M	63	8	5	1
A5092	M	56	6	6	1
A69290	M	66	12	6	1

TABLE IV

Group 3. Cases of Carcinoma of the Rectum With Metastatic Involvement of One-half or More Than One-half of the Lymph-nodes

Case	Sex	Age	Duration of symptoms, months	Glands dissected out	Glands involved
928M	F	69	3	2	2
4831-1/2J	M	50	6	5	4
A7039	F	65	24	7	7
A7624	F	64	8	5	3
A7631	F	60	12	5	3
A21961	M	33	4	5	5
A23639	M	54	5	6	3
A52248	M	54	3	6	3
A74532	F	43	36	12	6
A78911	M	39	3	8	7
A85834	M	56	4	4	2
A108406	M	55	7	5	3
A110220	M	64	1.5	3	2
A121346	F	29	6	6	3
A139873	M	60	2.5	6	3
A168690	M	40	1.5	11	10
A217336	F	36	1.?	9	9

## SUMMARY

Rectal carcinomas are the most common form of intestinal neoplasms and make up 4 per cent. of all the cancers of the body. The majority of patients are in the sixth decade. The males predominate slightly. The location of the growth on the rectal wall varies. About as many occupy the anterior wall as the posterior. The greater number of the growths are from the ampulla to the rectosigmoidal juncture. Adenocarcinoma is the most common type. Metastasis to the glands usually takes place slowly and the liver is the organ most affected by secondary growths. The other organs of the body are only rarely affected.

The size of the growth in the rectum cannot be relied on as an accurate index of the probable lymphatic involvement. The growths without lymphatic involvement tend to grow into the lumen of the bowel. The growths with slight lymphatic involvement tend to spread by direct extension and are slow growing. Carcinomas of the rectum with extensive lymph-glandular involvement tend to metastasize through the lymph-stream early. Occasionally metastasis may take place by emboli breaking off into the portal veins.

Metastatic lymph-glandular involvement can only be definitely determined by systematic microscopic study of all the regional lymph-nodes. The size of the lymph-node is not an efficient means of determining whether or not there is metastatic involvement. This is especially true if the amount of involvement is small, or if the process is an early one.

Systematic microscopic examination of all the regional lymph-nodes in carcinoma of the rectum offers, as it does in cancer of the stomach, the best method of establishing an accurate prognosis for the case.

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## SOLID CARCINOMA OF THE OVARY\*

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THIRTY-SEVEN cases of solid carcinoma and two cases of solid sarcoma of the ovaries were found in the examination of malignant tumors of the ovary at the Mayo Clinic between January 1, 1910, and August 1, 1921. These tumors were solid throughout or contained only relatively small cysts, due to degeneration and necrosis or retention. All cases of benign or malignant ovarian cysts, dermoids, and so forth, were excluded. During this time there were 4175 tumors of the ovary removed. Thus, solid malignant tumors comprise 0.93 per cent. of all ovarian tumors. During the same period 540 malignant ovarian tumors were removed; of these 0.086 per cent. were solid. These tumors are referred to in the literature as Krukenberg tumors following the publication of his paper in 1896.

In Major's fifty-five collected cases the average age of the patients was thirty-six years. In the Mayo Clinic series the average age was 44.2 years. Two patients were eight and sixteen years of age, respectively. Three were between twenty-one and thirty, seven between thirty-one and forty, ten between forty-one and fifty, fourteen between fifty-one and sixty, and one was sixty-six. Twenty-six patients were married and four were widowed. Twenty-four of these had from one to nine children each. Seven of the patients were single.

The most common symptoms were pain, tumor, ascites, loss in weight and strength, anorexia, and disturbances of the bladder and rectum. Pain, which was present in thirty patients, varied in type and location. As a rule, it was located in the lower abdomen and pelvis, but occasionally it occurred in the lumbar or sacral region of the back and radiated down the groin. It was usually described as a constant dull ache, bearing down or dragging. Occasionally it was sharp and severe, due to twisting of the pedicle, when it resembled the colic of a renal or ureteral calculus. Twenty-two of the patients complained of tumors. Twenty of the patients had themselves discovered the tumor, seven were discovered by the family physician, and ten were not discovered until the time of examination at the Clinic. This failure to recognize the tumor in ten instances illustrates the importance of a routine complete physical examination.

Thirteen patients (35 per cent.) had ascites varying from 250 c.c. to 6 or 7 litres. Seventeen patients were past the menopause from one to sixteen years. Four had prolongation of the period and increase in the

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menstrual flow, and ten gave histories of metrorrhagia of two months' to two years' duration. Seven had noticed irregularity in their periods.

Only two patients said that their general health was good. Twenty-two said it was below normal and thirteen that it was poor. Sixteen patients had normal appetites, fifteen had partial loss of appetite, and six had little or no appetite. Eighteen patients had lost from five to thirty-six pounds in weight; five were markedly cachectic. Seventeen complained of frequency, burning, or painful urination, and more or less continuous sensation of pressure, dragging, or weight in the bladder. One patient had had incontinence for six months due to the pressure of a large tumor. Sixteen patients complained of constipation and four of these had a sensation of fulness in the rectum with pain on defecation.

Physical examination of the patient reveals the presense of tumor, usually in the pelvis, often extending above the brim of the pelvis, and at times almost filling the entire abdomen. Fixation in such cases may be due to extension of the growth to the pelvic wall or adjacent viscera or to inflammatory adhesions. The blood picture shows varying degrees of secondary anæmia as is seen in malignancy in other parts of the body.

On bimanual examination of twenty-three of the thirty-seven patients the tumor seemed to be nodular, and in three, smooth. In the others the type was not noted. In seven patients the tumors were fixed, in the others more or less movable. The apparent consistency of the tumors varied considerably; it was usually recorded as "firm or rather hard," and occasionally "stony hard." In two the examiner had believed the tumor to be cystic.

*Diagnosis.*—The clinical diagnosis of solid carcinoma of the ovary is rarely, if ever, made definitely. As a rule the surgeon must wait for the microscopic diagnosis by the pathologist. The differential diagnosis includes the consideration of benign and malignant ovarian cysts, ovarian fibromas and dermoids, fibromas of the uterus, retroperitoneal tumors, and tumors of a displaced kidney. The pre-operative diagnoses in the thirty-seven cases were: Ovarian carcinoma in ten, ovarian cyst in five, dermoid cyst of the ovary in one, uterine fibroma in seven, pelvic tumor in seven, uterine fibroma with carcinoma of the fundus in five, retroperitoneal sarcoma in one, and carcinoma of the stomach with pelvic tumor in one.

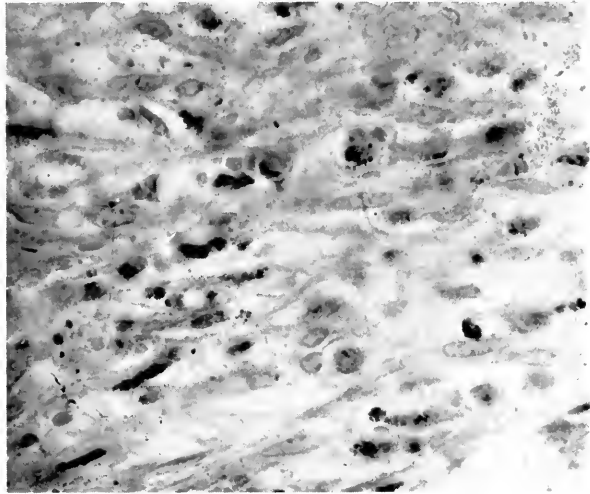


FIG. 1.—Melanotic carcinoma. Pigment lying within and between the cells. Marked absence of cell polarity. Prominent nucleoli (X 500).

*Treatment.*—The treatment for this condition is the same as for any other type of ovarian malignancy, namely, surgical and radiologic. Exploratory operation should be offered to all patients, even in the presence of ascites, unless metastasis can be definitely demonstrated. Palpation of an enlarged nodular liver with umbilicated nodules on the surface, enlarged hard inguinal or pelvic glands, or extension with induration of the broad ligaments would indicate a condition hopeless of relief through operation. Röntgenograms of the chest and pelvic bones may make it possible to detect metastasis to these regions. In such cases radium and the Röntgen-ray may temporarily relieve the pain and suffering and prolong the patient's life for a short time. Periodic abdominal paracentesis may be necessary on account of re-accumulation of fluid.

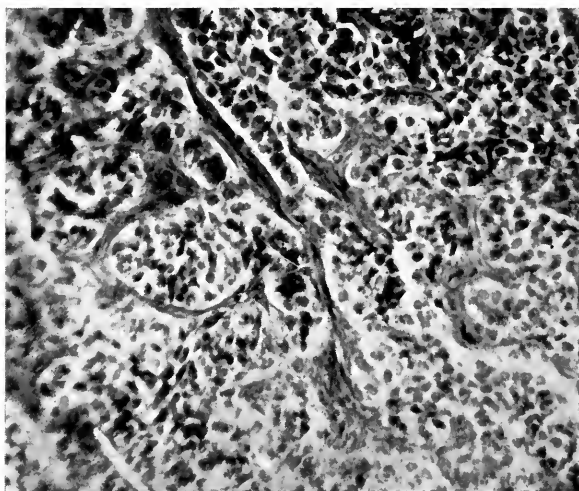


FIG. 2.—Solid carcinoma, Grade 4. No tendency to cell differentiation or gland formation; no polarity (X 200).

When recurrence takes place, radium and Röntgen-ray offer little even as palliative measures.

In cases amenable to surgery, post-operative applications of radium in the vagina and rectum, and Röntgen-ray applications to the abdomen and back, are of value, if recurrence is to be feared on account of the inability to remove all the malignant tissue. When recurrence takes place, radium and Röntgen-ray offer little even as palliative measures.

If the patient's general condition permits, the ovaries, tubes, and uterus should be removed at operation, unless the tumor is definitely encapsulated and limited to one ovary of a patient who is in the child-bearing period and anxious to bear children. In nineteen patients of the series, hysterectomy, either total or supravaginal, with removal of both tubes and ovaries, was performed. The ovaries and tubes were removed in eleven patients and one tube and one ovary in seven. In the one case in which both ovaries were affected and the patient also had inoperable carcinoma of the stomach, both ovarian tumors were removed on account of the danger of twisted pedicles.

*Data from Patients Traced.*—Subsequent data were obtained from thirty-seven patients by reexamination at the Clinic, questionnaires, or letters from the home physicians. Three of these patients were operated on a second time at the Clinic for recurrences. One of these returned four months later complaining of severe neuralgic pain down the right leg. This was found to be due to advanced involvement of the inguinal glands, which were removed with partial relief. Another returned at about the same interval

## SOLID CARCINOMA OF THE OVARY

with ascites and tumors of the omentum. The largest tumors were removed and Röntgen-ray and radium treatments were given. This patient lived eight months following the second operation. The third patient returned three months after operation with a small tumor on the skull, which proved to be carcinoma.

This series of cases indicates clearly that the so-called Krukenberg tumor, or solid carcinoma of the ovary, is often primary in the ovary. One case in the series, and a review of the literature, indicate that the ovary may be the site of tumor which is secondary to a malignant growth in the stomach or elsewhere. The case was diagnosed clinically as inoperable carcinoma of the stomach, and pelvic tumors. The patient gave a history of severe pelvic pain and insisted on an exploratory operation. An inoperable prepyloric carcinomatous ulcer was found which had penetrated the serosa and was attached to the pancreas. Rosenstein has called attention to the fact that it is not necessary for carcinoma of the stomach to penetrate the gastric serosa before metastasis may occur in the pelvis. In this case both ovaries were affected, and consequently removed; the right ovary weighed 950 gm. and the left 500 gm. Microscopic examination showed carcinoma with considerable fibrous tissue.

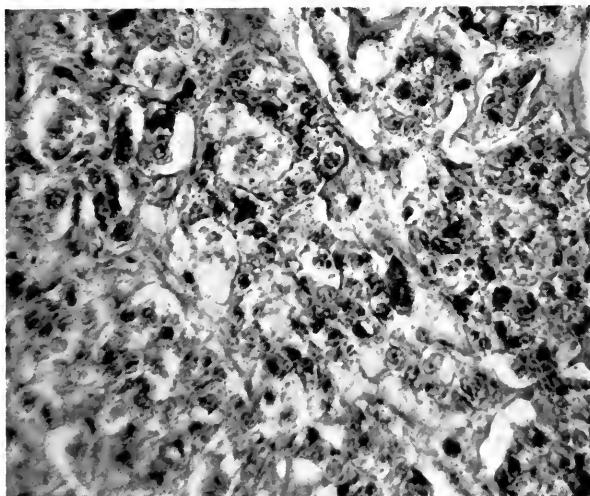


FIG. 3.—Carcinoma, Grade 3. Very slight cell differentiation with a slight tendency to gland formation (X 200).

In one case partial gastrectomy was performed in July, 1909, for carcinomatous ulcer on the lesser curvature. In February, 1912, both ovaries were removed; they were carcinomatous. No other evidence of involvement could be demonstrated at the time of operation, in spite of careful examination of the abdomen. The patient died from recurrence in the pelvis within eight months. In one case a Billroth operation No. 2 was performed for carcinoma of the stomach in June, 1910. In December, 1912, both ovaries were removed. Microscopic examination revealed carcinoma. Death occurred eight months later from recurrence in the abdomen. The last two cases are similar to a case reported by Hüsey in which the ovarian carcinoma occurred five years after operation for carcinoma of the pylorus.

In one case the ovaries and the gall-bladder were removed in February, 1913. The left ovary revealed carcinoma and the right ovary was normal. The gall-bladder contained many stones, and was chronically inflamed and

trabeculated. This patient died six and one-half years later, from carcinoma of the stomach. In one case a squamous-cell epithelioma was removed from the nose in 1912. Four years later the ovaries, tubes, and uterus were removed. All the organs were carcinomatous. The operation was difficult, because of marked local extension and numerous inflammatory adhesions between the tumors and the intestines. This patient died five days after operation. Necropsy showed metastasis to the left lung, but the stomach and other viscera were normal.

*Discussion of Findings.*—In one case a solid ovarian carcinoma was associated with carcinoma of the stomach. In two cases carcinoma of the ovaries

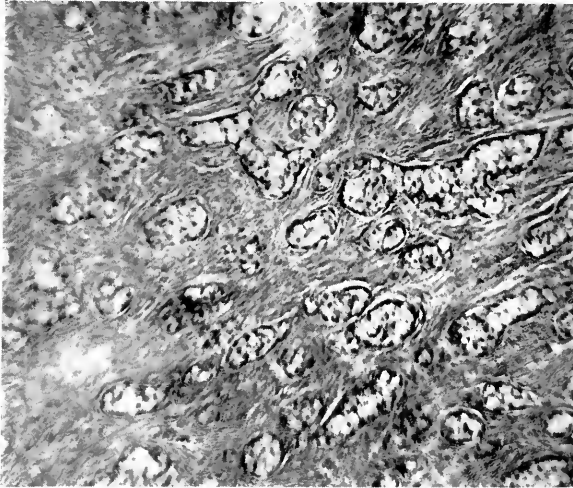


FIG. 4.—Carcinoma, Grade 2. Cells fairly well differentiated with gland formation. Migration of cells limited in degree (X 200).

was found two and one-half years after operation for carcinoma of the stomach. A fourth patient died from gastric carcinoma six and one-half years after both ovaries had been removed for carcinoma. In the first case there seemed to be a definite relationship between the carcinoma of the stomach and the solid carcinoma of the ovary. The time element in the second and third cases makes the relationship

questionable. In the fourth case the ovarian malignancy preceded that in the stomach by six and one-half years and any relationship between the two may be doubted.

*Type of Tumors.*—The tumors varied in size from 5 to 35 cm. in diameter. The weight varied from 30 gm. to 11,000 gm.; their average weight was approximately 1250 gm. In the heavier tumors calcification was marked, their consistency being almost stony. In twenty-four cases (65 per cent.) the involvement was unilateral and in thirteen bilateral. This is contrary to the usual findings in the literature, that the tumor is nearly always bilateral, which are used in the argument that bilateral involvement in organs, such as the kidneys and ovaries, in most instances indicates a primary growth in some other organ.

The shape of the tumors corresponded roughly to that of the normal organ. The surfaces were usually somewhat nodular and spotted with many small cysts 1 to 7 or 8 mm. in diameter. The consistency varied according to the degree of degeneration, necrosis, and calcium deposit. In the

large tumors necrosis was marked on account of the poor blood and lymph supply in the centre of the growth.

In the microscopic study of these tumors an attempt was made to classify the degree of malignancy into four groups, based on MacCarty's primary, secondary, and tertiary cellular differentiation and Broder's method of the classification of epitheliomas into Grades 1, 2, 3 and 4. The higher the degree of differentiation and specialization of cells, or the greater the tendency towards the adult type, the less malignant was the growth. Conversely, the less the differentiation and specialization or tendency towards the embryonic cells, the more malignant.

In the twelve tumors classified as Grade 4, no attempt was made at cell differentiation and gland formation. Four of the patients are known to be living and well, ten months, eighteen months, five and one-half years, and nine years, respectively, after operation.

In the eight cases death occurred from recurrence within from two to sixteen months after operation. The average interval was six and one-fourth months. One of the patients had melanocarcinoma.

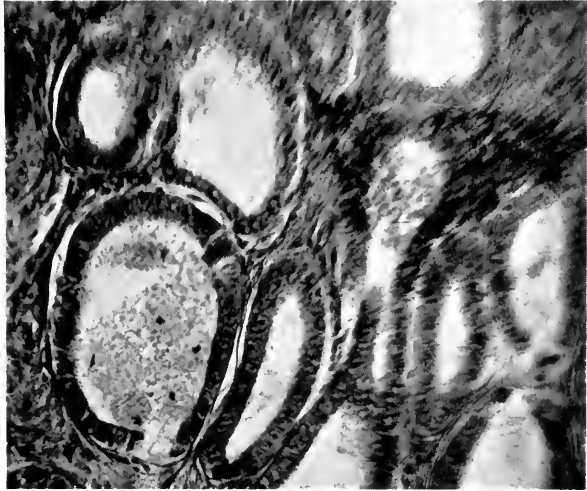


FIG. 5.—Carcinoma, Grade 1. Cells comparatively well differentiated with gland formation. Migration of cells in occasional areas (X 200).

Broders and MacCarty have called attention to the fact that the terms melanosarcoma, melanoma, melanotic sarcoma, chromatophoroma, and so forth, are misnomers. They have given good reasons why the pigmented malignant neoplasms arising in the skin, choroid, and other parts of the body should be called melano-epitheliomas. Cottam and Herzberg reported a case similar to the one of melanocarcinoma in this series. Their patient was thirty-eight years of age. They were unable to demonstrate metastasis or recurrence one month after operation, but gave a bad prognosis. Winternitz reported a case of a patient aged twenty-six years, whose growth he regarded as primary in the right ovary. The patient had cerebral metastasis for which operation had been performed by Cushing three months before discovery of the pelvic tumor. Andrews has reported a case of primary so-called melanotic sarcoma of the right ovary in a patient four months pregnant; the growth was removed. The left ovary was normal.

In the fourteen growths of Grade 3, microscopic examination showed little differentiation of the cells. In places there was a slight tendency to gland formation. Four of the patients are known to be living and well, two, three,

five and one-half, and seven and one-half years after operation. One patient died five days after operation. The other nine died in from two and one-half to twenty-one months after operation. The average interval between operation and death was eight and one-half months.

In the ten growths of Grade 2 microscopic sections showed the cells to be partially differentiated and forming glands. The cells of some contained mucus, and showed varying degrees of migration. It was impossible to trace one patient. The other eight died in from four to fifty months after operation, the average post-operative life being fifteen months.

In only one case was the growth graded 1. Microscopic examination showed comparatively well-differentiated cells. The cells showed only a

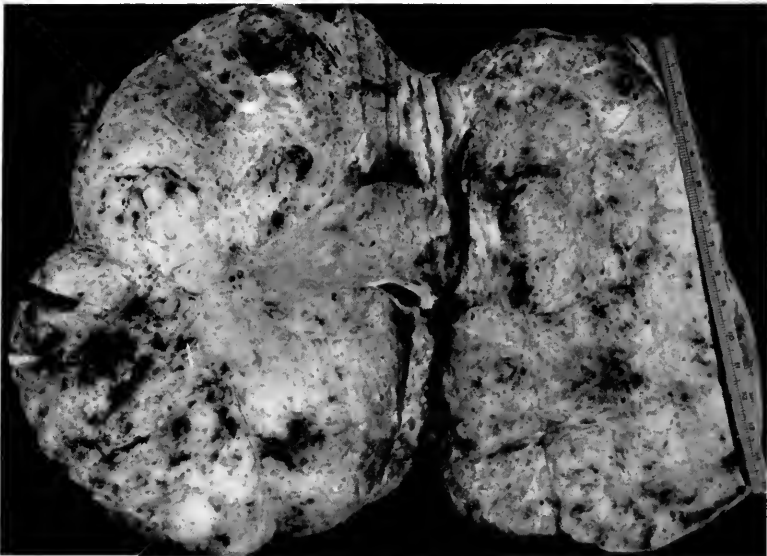


FIG. 6.—Carcinoma of the ovary in a child aged eight years. Specimen 20 by 14 by 9 cm.; cut surface.

slight tendency to migrate. The patient was alive and well two years after operation; she had gained eight pounds.

Of the thirty-seven cases twenty-six (70 per cent.) were graded 3 and 4 by microscopic examination. This bears out the clinical histories and shows that solid carcinoma of the ovary is highly malignant. Broders estimates that 75 per cent. of epitheliomas of the cervix fall into Grades 3 and 4. Thus, solid carcinoma of the ovary is only a little less malignant than that of the cervix.

The prognosis in solid carcinoma of the ovaries is comparatively poor. Formerly this tumor was believed to be relatively benign, but all the recent writers agree that it is more malignant than previous reports indicate. In this series only three patients were living and well after the five-year period, five and one-half, seven and one-half, and nine years, respectively, after operation. Two were living and well after three years, two after two years, two



after eighteen months, and two after ten months. In contrast to these eleven patients six were dead within six months, nine within one year, and four within two years.

## CONCLUSIONS

1. Solid carcinoma of the ovary may occur at any period of life from childhood to senility, the most common period being in the fourth and fifth decades.

2. The tumors are highly malignant and are more often primary than the recent literature indicates.

3. Solid carcinoma of the ovary may be bilateral, but in 66 per cent. of the cases the tumor was unilateral.

4. Melanotic carcinoma is occasionally primary in the ovary.

5. Melanotic carcinoma of the ovary is highly malignant, as is the same type of tumor elsewhere.

6. The general history is similar to that of ovarian fibroma with the additional symptoms of malignancy, loss in weight, strength, and appetite, and secondary anæmia. The growth of the tumor is usually rapid.

7. Ascites cannot be considered a criterion of malignancy, as it was present in 35 per cent. of the solid carcinomas and in 25 per cent. of the benign fibromas.

8. The treatment of solid carcinoma of the ovary is surgical removal followed by Röntgen-ray and radium, if total removal of malignant tissue is impossible.

9. Metastasis and local recurrence indicate a hopeless prognosis, but palliative treatment may be given by radium and the Röntgen-ray.

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## DOUBLE LIP

BY GEORGE M. DORRANCE, M.D.

OF PHILADELPHIA, PA.

DOUBLE lip may be present as a congenital deformity. It is usually seen after the eruption of the permanent teeth. I have never seen it develop in patients after twenty-one years of age.

The illustrations (Figs. 1, 2, 3) show a well-developed double lip in the case of a man aged twenty-one years, who states this condition has been

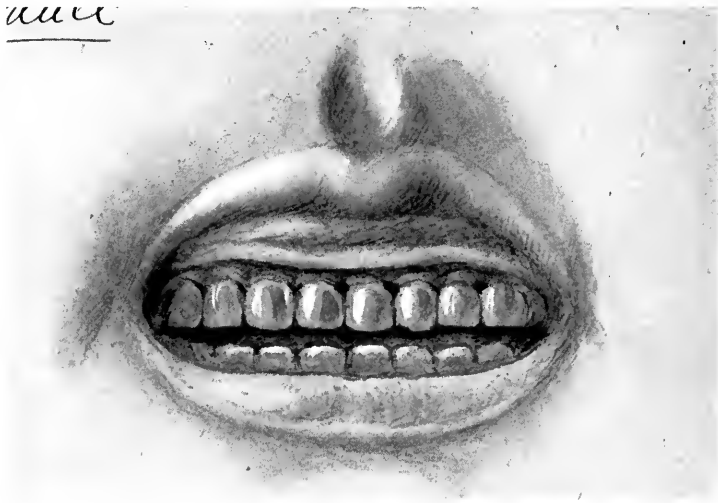


FIG. 1.—Double lip.

present since he was twelve years of age. There is, as shown in the illustration, a redundancy of the mucous membrane starting about one centimetre from the level of the labial alveolar sulcus. The submucous tissue is always in excess. The labial glands are enlarged. The condition is unsightly and frequently interferes with the speech. The only method for correcting this condition is surgical removal. The anæsthetic of choice is local anæsthesia.

The incision is begun at the labial alveolar sulcus immediately above the second bicuspid tooth and extends along the sulcus to the second bicuspid on the opposite side. A second incision is made, starting at the same point. This incision is made in the form of a crescent, as shown in illustration number two, and is completed by joining the termination of the incision on the opposite side. The redundant mucous membrane, submucous tissue and the labial glands in this area are excised. The frenum is necessarily divided.

## DOUBLE LIP

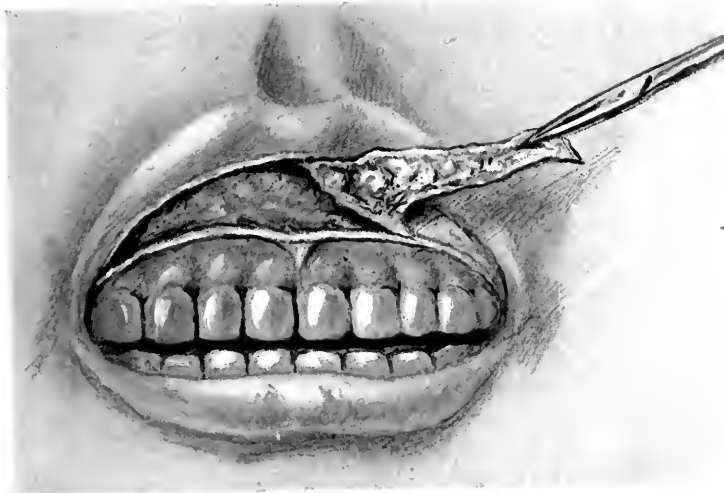


FIG. 2.—Removal of the redundant mucosa.



FIG. 3.—Completed operation.

## SUBMAXILLARY SALIVARY CALCULUS\*

By B. FRANKLIN BUZBY, M.D.

OF PHILADELPHIA, PA.

SALIVARY calculus, although comparatively frequently encountered, still goes unrecognized in a great many instances, and I feel that it is of sufficient importance to briefly review the causes, the usual symptoms, and the diagnosis and treatment.

The literature contains many case reports from all parts of the world, and all are agreed, that, like calculus formation in the gall-bladder, kidney and urinary bladder, a nidus is present which in the mouth can be composed of bacteria, food particles, cellular detritus and inspissated saliva. Then in the growth of the stone all of the inorganic salts (phosphates and carbonates of potassium, calcium and magnesium) present in the saliva can become crystallized out and laid down around the foreign material as a centre. The reason perhaps that the submaxillary gland is more frequently the seat of calculus formation than the others, estimated at 75 per cent. of all, is that the saliva from this gland is more viscid and more concentrated and therefore there are more salts which, because of the high viscosity, become crystalline more easily.

Primary infection followed by calculus formation may explain some of the cases, but this history is difficult to elicit as a rule. Carious teeth have been ascribed as a possible cause. Most sufferers seem to be in the third and fourth decades of life, although cases are reported in children and in the elderly. Males seem to be more frequently affected than females, explainable perhaps because infection of the mouth is more common in men or perhaps because of the use of tobacco.

The size of the calculus varies greatly, depending on its location. They are apt to become very large in the gland itself up to three cm. in diameter and weighing up to fifteen gms., without causing any deleterious symptoms, whereas in the duct, stones as small as two mm. in diameter can cause typical symptoms, the whole process being dependent upon obstruction. The stones as a rule are gray or yellow in color, rough on the surface, and in the gland are irregular in outline, while in the duct they are spherical or cylindrical. An occasional case has been noted with more than one calculus present; still, most of the cases present solitary stones.

The history as a rule is typical, especially where the stone is in the duct. The patient complains of a very painful and tender sudden swelling in the region of the affected gland appearing coincidentally with mastication or other causes of increased salivary flow. This gradually disappears in from fifteen minutes to two hours after the causative agent has passed. This painful swelling, because of increased tension in the mouth, interferes greatly with the

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\* Read before the Philadelphia Academy of Surgery, May 8, 1922.

movements of the tongue and deglutition. Talking also is painful, due again to tongue motion. This type of history is indicative of a stone in the duct acting as a sort of ball valve and causing a partial obstruction to the salivary flow, the gradual relief of which is coincident with the disappearing pain and swelling.

The history of a stone in the gland itself is different. There is no intermittent swelling, but instead a very slowly but steadily growing painful and tender tumor at the site of the involved gland, not influenced by the flow of saliva, although muscular action in eating may cause pain from pressure on the enlarged gland.

The diagnosis is not difficult, although rather important. Bearing the history in mind, if a bidigital examination is made with the finger on the outside pressing upward on the gland, and if the finger inside the mouth is brought forward along the course of Wharton's duct from opposite the lower molar tooth, a hard superficial shot-like body is encountered, which is especially tender on pressure. This is the calculus.

In the case of the glandular stone an illy-defined hard structure will frequently be made out in the substance of the gland which is the calculus in this type. An X-ray picture taken of the area always shows the calculus, and if the examiner is unable to palpate this in the duct the location is in the gland. Glandular calculi may be multiple, while duct stones are usually solitary. If a small probe is passed into the duct, one is able to definitely localize the stone. Exploratory puncture of the gland has been recommended for definitely determining glandular calculi, although to my mind this seems unnecessary.

Differential diagnosis should be made from bone tumor and malignancy which should present no difficulties if a careful history and X-ray are taken. Submaxillary lymphadenitis should not cause confusion. Occasionally air tumors are encountered in this region. Inspissated mucus alone, constriction of the duct and chronic hypertrophy of the gland all might be mistaken for calculus formation also, but all could be ruled out by X-ray, passage of a probe and palpation.

The treatment consists in the removal of the stone when in the duct and at a time between attacks when the gland has resumed normal size and relations. This is done best under ether or chloroform anæsthesia, because under local anæsthesia the movements of the tongue, which cannot be controlled, greatly hamper the operator, and the severe pain caused by upward pressure on the gland necessary to render the duct more prominent, is almost unbearable to the patient. Then also the lingual nerve and maxillary and facial arteries are very close to the duct and are in danger of injury unless the patient is under complete control. A direct longitudinal incision down to the stone through the mucous membrane of the floor of the mouth and through the wall of the duct will give adequate exposure. The stone then can usually be lifted out with forceps. Occasionally the stone is mulberry like on the surface and is difficult to remove in this way, so it is necessary to

resort to shelling out the calculus with the finger. No sutures are necessary as an incision 1.5 cm. long is always ample. After-treatment consists in a bland mouth-wash used frequently, and daily irrigations of the wound with the same solution.

Occasionally by slitting the opening of the duct the calculus can be worked forward and out of the orifice without further incision. This method as a rule is contra-indicated unless the calculus is very near the papilla because of subsequent stricture of the duct incident to the trauma. Recurrences in the duct are rare.

Some of the complications are abscess formation in the affected gland, glossitis and sympathetic salivary adenitis, all of which should receive appropriate treatment should they arise.

Occasionally obstructive duct symptoms may occur because of multiple minute calculi as in Case II. These as a rule are ejected if the pressure of the saliva is great enough, and appear as a gritty, creamy admixture of pus, mucus and inorganic salts. This type of patient should be watched carefully for a growth of a larger calculus in the gland or duct.

If the calculus is in the gland the whole gland should be removed because of the pain and possible abscess formation. If the gland is enlarged and tender at all times, even though the stone be in the duct, it should be removed primarily; the same is true if the symptoms are of long standing and it is felt that there is some possible purulent infection in the gland. All cases of stone in the duct, however, should not have the gland removed, for frequently the gland resumes normal function after the stone is removed.

Should abscess formation supervene, as evidenced by redness, heat, œdema and possible fluctuation, external incision and drainage is indicated and later, after the acute symptoms have fully subsided, the gland should be removed.

CASE I.—T. F.; age, twenty-nine; white; male; married; ex-pugilist, and laborer by occupation at present.

*Previous History.*—Exposed to mustard and tear gas in July and November, 1918. Compound comminuted fracture left lower leg and multiple trunk wounds due to shell fragments in November, 1918, in Argonne forest. Fracture of left mandible in 1915. Uses cigarettes to excess.

On August 3, 1921, complained of a sudden oncoming soreness in the right submaxillary region, which was coincident with the intake of food. He had difficulty in swallowing and in talking, and complained of "thickness in his throat."

Upon being given a hard roll to eat, a swelling five cm. in diameter and elevated one cm., appeared promptly in the submaxillary region while masticating and disappeared within fifteen minutes after he stopped eating, after which bidigital examination revealed a tender submaxillary salivary gland on the right side, but of normal size. A shot-like immovable body, which was exquisitely tender on pressure, was felt opposite the third molar tooth on the right side. An X-ray showed a shadow 7 x 4 mm. in this plane. The removal of the calculus was attempted under local cocaine adrenalin anæsthesia, but failed due to inability to keep the patient's tongue out of the operative field and the pain incident to the upward pressure on the gland. One week later under ether an incision 1.5 cm. long was made longitudinally over the duct down to the stone, and it was removed.

## SUBMAXILLARY SALIVARY CALCULUS

The stone was of the size seen in the X-ray, was yellowish white in color and the surface mulberry-like. Convalescence was uneventful, but on October 24, 1921, all previous symptoms returned, suddenly as before, accompanied by fever and a moderate-sized tender swelling of the right submaxillary gland, which persisted between the intake of food but which was greatly increased by eating. He also had a bad taste in his mouth and flaky mucopurulent particles were extruded from the duct orifice. X-ray at this time was negative for stone. With these symptoms in view and the previous history it was decided to remove the entire gland at once, which was done by Dr. A. P. C. Ashhurst at the Episcopal Hospital with complete amelioration of all symptoms. The pathological report was "acute salivary adenitis. No calculi present."

CASE II.—L. C. E.; age, thirty-four; white; male; married, and a clerk by occupation. Previous history negative. Smokes cigars in moderation. On August 25, 1921, without previous discomfort and while eating lunch had a sudden severely painful swelling of the neck in the region of the left submaxillary gland so marked as to preclude finishing his lunch and accompanied by slight nausea. He was seen within a half hour of the onset with a grayish-white granular plug two mm. in diameter protruding from the orifice of Wharton's duct and a swelling of the left submaxillary gland fully as great as that shown in Fig. 1, B, which was exquisitely tender. This soft granular material was removed piecemeal and was followed by a gush of saliva from the duct in the affected side. The following day, while it was slightly tender, the gland was normal in size, and there were no masses palpable, neither along the duct nor in the gland itself. There was still a slight amount of detritus protruding from the duct orifice. No recurrence of symptoms has occurred since that time, and an X-ray taken on February 14, 1922, shows an indistinct shadow, roughly triangular in shape and about four mm. on a side located in the region of the submaxillary gland just posterior to the third molar tooth. In view of the absence of symptoms and the uncertainty of the X-ray findings, I feel further interference is unnecessary until further symptoms arise.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting Held March 22, 1922*

The President, DR. JOHN A. HARTWELL, in the Chair

## ARTHROTOMY FOR CHRONIC ARTHRITIS OF KNEE

DR. HAROLD NEUHOF presented a man forty-seven years of age, from the First Surgical Division, Bellevue Hospital, who was presented before the Society a year ago and is shown again because the question came up at that time as to what the ultimate result might be. In brief, he had been suffering from this monoarticular lesion of unknown origin for two and a half years before the time of operation, with pain and disability that were progressive despite active treatment by massage and baking, and extraction of teeth, etc., to attempt to eliminate foci of infection. The knee-joint was almost completely fixed, the range of motion being a very few degrees. Pain was severe and persistent so that the patient had been unable to attend to his work, involving standing for eight or ten hours a day, for several months. The X-ray picture was that of a chronic arthritis. Operation consisted in a long vertical curved incision mesial to the patella and lateral retraction of the patella after the joint was opened. There was pronounced thickening of the synovial membrane, many pedunculated fat masses, and some free fibrous bodies. Limitation of motion was found to be chiefly due to a broad fibrous band anterior to the crucial ligaments extending from the tibia to the intercondyloid portion of the femur. After this was excised the patella could be laterally drawn beyond the femur and the joint well flexed. The remainder of the operation consisted in the free removal of the fat masses and excess portions of the altered synovia. Passive motions were begun the day after operation and continued with increasing range. No other after-treatment was employed. When shown last year the range of motion was from  $100^{\circ}$  to  $180^{\circ}$ , no pain, and ability to continue his occupation. He has been able to work uninterruptedly and in comfort since that time, and now the range of motion is from  $85^{\circ}$  to  $180^{\circ}$ . Except for some dull ache in bad weather, there is no pain. He is a heavily built man, weighing 240 pounds, and is on his feet almost continuously from morning to night.

## LATE SUTURE OF BRACHIAL PLEXUS

A second case, presented by Dr. Harold NeuhoF, was a man, thirty-six years old, from the First Surgical Division, Bellevue Hospital, who six weeks previously had been stabbed in the left side of the neck. An active hemorrhage followed and he was taken to a hospital where an operation was performed for the control of bleeding. The patient noted



paralysis of the arm directly after his injury, and this remained unchanged during the succeeding weeks. There was as well constant dull ache in the left shoulder and wrist, and numbness and tingling in the thumb and index fingers.

Upon examination there was a flaccid paralysis of the upper arm type, with marked atrophy of the shoulder and arm, and atrophy to a lesser degree of the forearm and thenar eminence. The deltoid, supra- and infra-spinati, biceps, and coracobrachialis were totally disabled, with the associated complete loss of abduction at the shoulder and flexion of the elbow. The teres minor appeared totally paralyzed, and the latissimus dorsi, subscapularis, brachialis anticus, and supinator longus were partially disabled. Biceps and radioperiosteal reflexes were absent. Sensation was lost over the shoulder in an area corresponding to the circumflex nerve and over the first two fingers and radial side of the hand in an area referable to the musculo-cutaneous and median nerves. Reaction of degeneration was present in the paralyzed muscles.

The lesion was clearly a complete one of the upper trunk of the brachial plexus a short distance beyond the junction of the fifth and sixth cervical nerves and apparently a partial one of the middle trunk. The question came up as to whether operation should be performed at so long a time after injury.

At operation, two months after the injury, considerable cicatricial tissue was found about the site of the divided upper trunk. The lesion was directly beyond the junction of the fifth and sixth roots. The divided ends were separated by about two cm. Normal nerve bundles were found after removal of about one cm. of scar tissue from each nerve end. The middle trunk presented a slight fusiform thickening with induration, but transmitted electrical stimuli. The divided ends were freely mobilized. The nerve ends were approximated by Carrel sutures passed between fasciculi, and the nerve sheaths by very fine catgut. There was no tension on the suture line with the head bent to the affected side and the shoulder elevated.

The result seen now, sixteen months after operation, can be largely ascribed to the energy with which the patient pursued the after-treatment. This consisted in wearing an abduction splint for several months after operation and in massage and, later, electrical stimulation three times a week. Six months after operation there was no sign of improvement in function. The atrophies were as marked as before operation, if not more so, and the reaction of degeneration was complete in the affected muscles. The patient, however, continued treatment regularly. The first sign of improvement was noted seven months after operation, when sensation began to return over the areas in which it had been lost. Ten months after operation there was slight power in the deltoid, fair power in flexion at the elbow, and the shoulder and arm were beginning to fill out. From that time on the improvement has been rapid. The patient is now able to pursue his occupation as a mechanic. There is excellent power in the deltoid, biceps, and coracobrachialis. The spinati and supinator longus show a lesser degree of recovery. Sensation is normal. Reflexes are lively. The

electrical contractility is approximately normal. Further improvement may be confidently anticipated.

#### CRANIOTOMY FOR CONGENITAL CRANIOCEREBRAL DEFECT AND EPILEPSY

DOCTOR NEUHOF, in presenting the next two cases, stated that he had not seen any such abnormality described in the literature. Cranial gaps of congenital nature had been accidentally encountered, but apparently had not given rise to any manifestations. He had not found post-mortem or other examinations that might have indicated the existence of lesions beneath the skull. The pathological picture was similar but not identical in both cases.

In the first case, a boy, eighteen years old, from the Surgical Service of Doctor Lilienthal, Mount Sinai Hospital, had epileptic attacks which began about a year before operation. They were generalized and became progressively more frequent. The examination was negative except for the skull defect. It was indistinctly felt, but is clearly seen in the X-ray picture. This shows an almost circular defect about three by three cm. in the right anterior parietal region, with sharply outlined margins. The appearance is that of an operative removal of bone. Operation was performed, about two years ago, in the hope that some remediable lesion such as a cyst might be found beneath the skull defect. A large osteoplastic flap was made to include the abnormal bone area. As this was turned down the inner surface was found intimately attached to the underlying structures. The inner surface of the gap in the bone was partly covered by exceedingly thin shells of osseous tissue, for the most part measuring one by five-tenths cm. No normal dura was seen. This membrane was represented by a fibrous shreddy tissue in which additional bone flakes were embedded. Nor could the pia-arachnoid be recognized as such, a thin layer of opaque tissue being adherent to and obscuring the adjacent brain surface. This was flattened out as a whole, depressed, and the convolutions were small and insignificantly developed. Incorporated in them were several of the flaky bone fragments. These were removed by careful dissection. It was evident that no remediable lesion existed and the flap was therefore replaced and the wound closed. Epileptic seizures happen to have been less frequent and for the most part less severe since the time of operation, but there is of course no reason to believe that operation has been of any benefit.

#### CRANIOTOMY AND FASCIAL TRANSPLANT FOR CONGENITAL CRANIOCEREBRAL DEFECT

The second case, a boy, seventeen years old, also from the Surgical Service of Doctor Lilienthal, Mount Sinai Hospital, gave a history of several injuries to the head without any immediate manifestations. The cranial gap cannot therefore be linked with trauma. He has had frontal headaches for several years and a gradually altering mental disposition. Its most striking aspect has been a frequently repeated depart-

ure from home from varying periods of days to weeks. Physical examination revealed no abnormality other than the cranial defect. This was a depressed area in the right posterior parietal region. The X-ray picture showed a clean-cut defect in the bone about two and a half by three cm. Operation performed in September, 1920, was done on the tentative diagnosis of a subcranial lesion with bone absorption. An osteoplastic flap was made with its base close to the mastoid, the involved bone being included in the flap. It was found greatly thinned, absent in places, and the tissues occupying the defect were soft enough to be cut with a knife. The rim of the defect was well defined below, shading off into the normal skull above. The dura was entirely gone over an area about two and a half by two and a half cm. The exposed brain surface was depressed, of bluish color and with bare traces of convolutions. Surrounding this area was an elevated, firmly infiltrated ring of brain cortex about one and five-tenths cm. wide, interpreted as sclerosis. The margins of the dura were freshened and a section of fascia lata about five by five cm., taken from near the knee, was sutured in place to cover the exposed brain. The flap was then returned and sutured in place after removal of the shreddy tissue occupying the skull defect. The microscopic examination of the removed fragments, in this as in the preceding case, showed degeneration and atrophy of bone and soft parts. Apparently headache and the mental condition have improved since operation. Considering what was done at operation and the operative findings this result can only be interpreted as a psychical effect of operation.

DR. A. V. MOSCHCOWITZ, in referring to the last case, said that within the last two months he was asked to see a child, a boy of five or six years of age, in the pædiatric service of Mt. Sinai Hospital. This boy had a number of large defects in the skull, which could be palpated with the greatest ease. Almost everyone who saw the child made a diagnosis of congenital lues, but subsequently it was proven to be a case of a so-called "Lueckenschädel," and had nothing to do with lues.

DOCTOR NEUHOF, in closing, stated that of course the condition of cranial gap, termed "Lueckenschädel," had been reported a number of times. The defect is usually single but may be multiple. It is usually accidentally noted. But it has been previously shown, as far as he is aware, that the defect is not in the skull alone but apparently is a defect involving the cerebral coverings and the brain substance as well.

## TRAUMATIC RUPTURE OF THE SPLEEN

DR. JOHN F. CONNORS reported R. B., six years old, schoolboy, admitted to Harlem Hospital, January 28, 1922, with the following history: One-half hour before admission was struck by an automobile while attempting to cross the street. It was said that the front wheel passed over his body. The abdomen was distended, with pain in the epigastrium. Tenderness present all over, but most marked in the upper half. There is slight rigidity of the abdominal wall. No pain in shoulder.

The following morning he was apparently comfortable, but had some abdominal distention. He had vomited twice during the night. His temperature was normal, and pulse was 120. He presented a picture of one who had lost a great deal of blood, and a diagnosis of a ruptured spleen was made from the blood count, which showed his red blood count had been reduced from four to two million.

*Operation.*—An upper midline incision about three inches long was made. This was extended with a transverse incision to left from mid-portion of first incision. Free blood was found in the peritoneal cavity. On exposure of viscera, spleen was found to have a stellate rupture down to the hilus. Vessels ligated and spleen removed. On account of the condition of the child the abdominal wound was closed by through-and-through sutures of silk. Skin closed with catgut. Infusion of N/Saline attempted, but only a small amount of fluid injected. Later the same day 200 c.c. of blood from the mother was given.

This case is not presented because of its diagnosis or recovery, but rather to bring to mind the theory of Steubenrausch, as quoted by Michelson, who have seen cases operated upon one or more years after splenectomy, in which they found nodules scattered throughout the peritoneum, which showed characteristics of splenic tissue. These findings warrant the thought that small accessory spleens undergo hypertrophy and function in place of the missing organ. All of his cases of splenectomy for trauma were under eight years of age with one exception, and have passed through the diseases of childhood and are apparently in good physical condition. A case was reported a few days ago by one of his assistants upon whom he performed an autopsy on March 10, 1922. This patient died of influenza. In it he found a spleen three inches by one and one-quarter inches in the place where the organ should be. Just above this he found an aberrant spleen one inch in diameter, although this case had been splenectomized one year previously for Von Jaksch's anæmia.

#### ACUTE PANCREATITIS

This condition was illustrated by Doctor Connors in presenting the case of F. R., housewife, thirty-four, white, admitted to Harlem Hospital, November 4, 1921. Chief complaint, pain in right hypochondrium.

*Present History.*—Illness dates back to about six months ago, when she began to have attacks of pain in right hypochondrium followed by nausea and vomiting. Vomiting partially relieved pain. November 2, the patient had a similar attack which has continued to date. She complains of a pain in the hypochondrium which radiates to the back, nausea, and vomiting. For the past two days she has noticed that she is becoming yellow (no previous history of jaundice). No history of clay-colored stools. On the day of operation she was seized with a knife-like pain in the midline of the epigastrium which radiated to the back. She went into collapse with a marked cyanosis.

*Operation.*—Transverse incision, peritoneum opened, exposing duodenum, gall-bladder and liver. Gall-bladder filled with stones. Several

stones in the cystic duct, but none in the common duct. The head of the pancreas was greatly enlarged and indurated in spots which were surrounded by areas of softening, but at no place could fluctuation be felt. The gall-bladder was removed and the common and hepatic ducts were opened, which were found to be free from stones. On account of the condition of the head of the pancreas a tube was sewn into the common duct for drainage purposes. The appendix was removed, although it appeared normal. The abdominal wall was closed by layers.

This patient had a very stormy convalescence. For five days she had a temperature ranging between 104 and 105° and was extremely ill. There was a great discharge of bile through the wound, but the stool induced by enemata was not the clay-colored stool one would expect to find, rather one that showed evidence of bile passing through. On the fifth day the stools were normal in color. She was transfused on the fifth day. On the tenth day the tube was found on the dressing when it was removed. The amount of bile decreased daily until the sixteenth day, when she had another attack of pain in the hypogastrium and the wound opened spontaneously with a discharge of bile, which relieved the pain. During this time her jaundice completely disappeared. She remained well for two weeks, when her wound opened again with a discharge of bile which lasted for three days. Although the wound has remained closed and there has been no jaundice or clay-colored stools, nevertheless she has made very little progress until the last few weeks, when she has improved markedly, having gained twenty pounds in weight and presents no digestive symptoms. This case brings about the question of the cause of the condition found in the pancreas. The appearance of the gall-bladder and the pathological examination would not warrant the thought that it was caused from the biliary tract, for there was no difficulty in passing the probe into the duodenum. Therefore, it seems that one must look to the lymphatics as to the cause of her condition.

The classification of the pancreatic condition is an open question. The fact that at the time of operation they were unable to feel any distinct point of fluctuation points to the lymphangatic (non-suppurative) form of acute pancreatitis, as described by Deaver and Pfeiffer. In most cases of acute pancreatitis there are evidences of fat necrosis which did not appear in this case, and in most cases there is no jaundice, but when one considers that the common duct passes through the gland itself, and appreciating the size of this pancreas, one can easily explain the jaundice in this case.

DR. CHARLES E. FARR referred to a case he had seen with jaundice that came to autopsy in which there was complete necrosis of the pancreas. Another case, clinically pancreatitis, also had jaundice, but no operation nor autopsy was permitted. Both cases had definite cholecystitis and cholelithiasis.

DOCTOR CONNORS, in closing, admitted that there was a possibility of his having been mistaken, but the condition found in the gall-bladder on pathological examination showed it to be only slightly inflamed. There was nothing in the common bile duct nor in the hepatic duct. There was no area that

could be called fluctuation. No jaundice was present before operation and there was no fat necrosis.

#### EMBOLISM OF THE BRACHIAL ARTERY

DOCTOR CONNORS recited the case of a patient, a schoolboy, eleven years old, admitted to Harlem Hospital, December 8, 1921, with a diagnosis of compound fracture of the left humerus.

There was a wound on the flexor surface of the elbow with a marked deformity of the lower end of the humerus. He complains of numbness of the fingers of the left hand, which were cold and pale. However, he is able to move his fingers. At the elbow there is displacement, backward, with excessive motion, especially laterally. There is no definite crepitus, some swelling, no discoloration. The wrist shows a deformity of a Colles' fracture. The hand and arm are cold. X-ray showed a supracondylar fracture.

When the reporter saw this patient his hand and forearm were cold and mottled. There was no pulsation in the radial artery. There was a marked swelling extending from the elbow to the tips of the fingers.

An incision was made four inches in length, longitudinally on the outer aspect of the lower part of the arm, elbow and forearm, the brachial artery being easily identified. One and one-half inches above the joint an organized thrombus was found which was about 1.5 cm. in length. One could readily see the pulsation ceased at the thrombus. It was necessary to reduce the dislocation to relieve the tension on the artery. When this was accomplished a catgut ligature was placed around the artery, but not tied, but held firmly enough to stop the circulation. An incision was then made in the artery just below the blood clot, from which there was no bleeding. All efforts to remove the clot failed. Another incision was made about a half inch above the clot, from which there was active bleeding, and which could be controlled by the ligature. With the aid of a large, curved, round needle which was passed behind the artery, the clot was dislodged from its site to the opening above. An effort was made to remove it through the upper opening but without success. With the needle, which was passed behind the artery, he was able to milk it free, and it appeared at the lower opening, and from this point he was able to remove it. The circulation was immediately resumed below the clot. A small, hot sponge was applied over the incisions on the artery for a few minutes which checked the bleeding noticeably and after a few minutes more the bleeding had stopped. A few strands of silkworm gut were placed in the wound superficially, the arm put in abduction and constant heat applied. That night the pulse rose to 150 and the temperature to 104° F. After that he made an uneventful recovery. The radial pulse was watched for very carefully, and it appeared five days post-operative. The color of the forearm and arm was much improved the following day. At the end of the third day the color was almost normal, but the swelling persisted till he was taken home ten days post-operative. He was not examined neurologically and his first knowledge of nerve involvement came yesterday.

## CONGENITAL CYSTIC KIDNEY

DR. HOWARD LILIENTHAL considered this case report very important, not because the pulse came back, but because the bleeding stopped after making such large openings in the artery. He could understand that if the bleeding could stop spontaneously it might be a disadvantage to try to close by suture. If the bleeding ceased and there was no infection, there should be no secondary hemorrhage. He understood that the incisions were in the long axis of the vessel.

DR. HAROLD NEUHOF thought that if the pulse return had been delayed for several days, as he had understood, the return could be accounted for by canalization through the thrombus. In his experience the only reliable evidence of restitution of circulation through an artery was the immediate return of pulsation in the vessel distal to the site of operation. This held true of some lesions of the brachial and popliteal arteries he had operated upon.

DOCTOR CONNORS, in closing, said that immediately after the removal of the clot, in as far as the artery was visible, the circulation had returned in the brachial artery. The next day the color of the arm was normal. The radial pulse returned on the morning of the fifth day, but all the circulation he could vouch for was what he saw. The fact that the artery did not bleed was not surprising, for he had operated upon a case in France, removing a piece of high explosive from the carotid, in which there was no bleeding. And in the cases of arteriovenous aneurisms which he had done, it was surprising how easily the bleeding was controlled after suturing the artery. The incisions in the artery were longitudinal.

## CONGENITAL CYSTIC KIDNEY

DR. WILLY MEYER presented two patients in whom he had done Rovsing's operation for congenital cystic kidney.

The first case, a female, thirty-four years old, married, two children, had a bilateral affection. She had suffered from frequent urination, pain in abdomen and back, for several years. In both lumbar regions a well-palpable tumor was found with an irregular surface, which moved up and down with respiration, the right being larger than the left. Air inflation of the colon showed the tumors situated retroperitoneally. As the condition was bilateral, the diagnosis of congenital cystic kidney could be made with certainty.

The first operation, on the right side, was done on October 15, 1918, at the patient's request, under general anæsthesia, at the Post-Graduate Hospital. The usual posterior hockey-stick incision was made. After division of the deep fascia the kidney appeared, and could be brought in front of the wound. It showed the usual beautiful picture seen in cystic kidneys, the cysts shining in all colors of the rainbow. All the cysts that could be reached were opened and some of the sacs excised. The organ was quickly reduced to less than half its previous size and replaced; the wound was sutured in layers, a split drainage being introduced at either end. Primary union followed.

On March 6, 1919, the same operation was done on the left side, again under general anæsthesia, at the request of the patient, this time at the Lenox Hill Hospital. The same picture was found and the same technic followed. Primary union again took place.

To-day the patient is greatly improved, has gained in weight and is able to attend to her daily work.

The second case also was a female, forty-three years old, mother of several children. She had been sent to the Lenox Hill Hospital with the diagnosis of intraperitoneal, probably colonic tumor. However, the history revealed that she had been suffering from pain in both sub-costal and lumbar regions, right more than left, for the last eight years. On the right side there was a large, freely movable tumor, low, as a movable kidney, with distinct ballottement on bimanual palpation; its surface was irregular. On the left side the tumor was smaller, but well defined. Congenital cystic kidney was diagnosed, and the retroperitoneal position again proved by blowing up the colon with air. Operation was done on April 26, 1920, under regional and local anæsthesia, the eleventh and twelfth dorsal and first and second lumbar nerves being injected; during the operation direct injection of the twelfth intercostal and ilio-hypogastric nerve was added. The operation proved quite feasible and the patient only complained of some annoyance when the tumor was lifted out of its bed. The size of the kidney could again be reduced to less than half, so that reduction was easy. Closure by layer sutures. Primary union followed.

To-day the patient still has some pain in the right side and complains of sleepiness. So far she could not make up her mind to have an operation performed on the other side. She has gained decidedly less in weight than the first patient.

The speaker had had no chance to test the function of the kidneys, as he succeeded only a few days ago in locating the two patients.

He also referred to a third case on whom he operated a few years ago on one side, the second operation being performed at the Mayo Clinic. The patient, a young man, is perfectly well apparently.

Rovsing's operation certainly means a great step forward in the treatment of this otherwise fatal condition. It will be of interest to watch these patients to see how long the improvement will last. Eventually, a second operation might be performed, should the cysts that could not be reached at the first, increase in size and compress the renal parenchyma.

DR. EDWIN BEER stated that it would be very valuable if such operations on congenital cystic kidneys led to the result described by Doctor Meyer. It was highly doubtful whether, judging from the pathology of the disease, the incision or excision of multiple cysts would be followed by relief of the kidney disturbance and improvement in function. Before one can really definitely decide upon the value of the Rovsing operation, it would be necessary to study a great many such cases with careful pre-operative and post-operative functional kidney tests; otherwise, one will have no idea as to whether improvement follows the above operation. These cases of congenital



## TUBERCULOSIS OF SHEATHS OF FLEXOR TENDONS

cystic kidney often live to be fifty years old without any symptoms, and as far as he could see from Doctor Meyer's presentation, there was no cogent reason for believing that either one of his cases had been improved by the operation. Until Doctor Meyer was ready to present careful pre-operative and post-operative functional studies, Doctor Beer believed the improvement, which Doctor Meyer emphasized in these two cases, would have to remain sub-judice.

DOCTOR MEYER replied that, as mentioned before, he had not been able to get hold of the patient in time to have these tests made. But as regarded the first patient one could see that she is in good general condition, able to attend to her housework. The second one, who only had one side operated upon, is not so well. This operation offers the only way of keeping these patients alive.

## TUBERCULOSIS OF SHEATHS OF FLEXOR TENDONS OF FOREARM AND HAND—RADICAL EXTIRPATION

DOCTOR MEYER stated that sometime previously he had presented before this Society two male patients in whom he had extirpated radically the sheaths of the extensor tendons of the fingers and forearm. Both had regained full function of their hand and now showed a patient with the same trouble on the flexor side.

A woman, thirty years of age, who had noticed increasing weakness and uselessness of the hand for two years before she came under his care. The typical picture of this condition was present: A distinctly fluctuating sac on the volar side, divided by the annular ligament in such a way as to produce the well-known hour-glass shape. On pressing the swelling above the ligament, one could distinctly feel the soft crepitation of rice-corpuscles present. Radical operation was decided on and done on April 29, 1920. Sehrt's metal tourniquet was applied to the upper third of the arm, not in the middle, over a compress of gauze, in order that the musculospiral nerve might suffer as little as possible. A longitudinal incision was made over the tumor, the annular ligament divided, the median nerve exposed and pulled aside. The superficial vascular arch was doubly clamped, divided and ligated. The presenting bursa was then treated as a tumor to be excised, loosening it bluntly all around into the depth of the palm of the hand. It was then excised, the rice corpuscles removed, great care being taken to extirpate the entire mass in one piece, advancing from tendon to tendon and carefully preserving the synovial covering of the tendon itself. At the completion of the extirpation, the bare tendons crossed the wound in their anatomical relation. The wound was flooded with a five per cent. iodoform ether solution, in which the speaker said he had the greatest confidence in tuberculous cases. The tourniquet was opened, the vessels secured and the skin-wound closed with interrupted silkworm gut sutures; this was then covered with sterile rubber tissue to provide for the moist blood-clot formation; a dorsal splint was put over the dressing, keeping the

fingers in full extension. The first dressing was allowed to remain in place for fifteen days, with the patient out of bed almost the entire time. The wound was found healed. The patient was then put under a careful physical treatment in order to improve the function of the various fingers. She now shows a perfectly useful hand, enabling her to do all her housework. She can form an almost complete fist, the motion still somewhat lacking is that of flexion of the extended fingers.

These cases prove that the radical extirpation of the tuberculously inflamed sheaths of the extensor, as well as flexor tendons, is feasible, and that careful after-treatment can restore the function of the fingers and hand.

The only other method of treatment that could come into consideration would be the X-rays which have been tested to advantage of late in tuberculosis of various organs. However, the final result of the treatment being doubtful, and a number of sittings being required, the speaker, at the present time, would prefer the operative procedure.

#### APPENDICOSTOMY FOR CHRONIC ULCERATIVE COLITIS

DOCTOR MEYER presented the case of a patient, female, twenty-one years old, who showed in April, 1918, all the signs of ulcerative membranous colitis, neither of specific nor tuberculous origin. The trouble had existed for four years. Rectoscopy showed ulceration near the sigmoid.

An appendicostomy was performed on May 6, 1918, through an intermuscular incision, stitching the base of a rather long appendix to the middle of the peritoneal incision, and allowing the organ itself to pass through the layers of the abdominal wall in a slightly oblique direction, the tip of the appendix projecting about three-quarters inch. The meso-appendix was carefully preserved; layer suture finished the operation. With the abdominal wound dressing in place, the projecting appendix tip was then amputated about one-half inch above the abdominal wound and its patency tested. Its lumen was found to be permeable, although at two places a slight stricture had to be overcome; the base was then gently ligated with a catgut thread and a dressing applied. After forty-eight hours this ligature was removed, the distal end being found necrotic. A few days later the slough came off, and regular irrigation of the large intestine was started. Of all salts, that of nitrate of silver, used in gradually increasing doses, appeared to have the best effect. During all these years the fistula, which had formed in the shape of a lip-fistula, was so small that it was hardly discernible, but the patient was able to introduce a soft-rubber catheter, through which the irrigations were kept up. There has never been any secretion; dressings were not needed.

The trouble as such was cured and the patient advised not to have the opening closed, but rather keep it as long as possible as a safety valve.

Recently, after a somewhat long intermission, it was found difficult to reintroduce the soft rubber catheter and it took quite some careful manœuvring to widen the canal without perforation. The patient reports

## SCHEDE'S OPERATION FOR EMPYEMA WITH BRONCHIAL FISTULA

that off and on she feels a stiffening of the organ, which has also been observed by the speaker in this case, evidently due to the presence of the two strictures, in consequence of which the lubricant with mucus and fecal matter which eventually enters the canal could not be readily discharged. It may become advisable now to excise the appendix. Meanwhile the patient has gone through two confinements, without any trouble from the scar or interfering with the efficiency of the appendicostomy.

Comparing the effect of cecostomy and appendicostomy as regards the patient's comfort, the latter procedure is decidedly preferable, as it enables the patient to carry out the irrigation of the large intestine from above, without having all the discomforts of a large intestinal fistula.

## SCHEDE'S OPERATION FOR EMPYEMA WITH BRONCHIAL FISTULA

The case presented by Doctor Meyer was a young man, twenty-six years of age, who had been in the Medical Division of the Lenox Hill Hospital for acute pneumonia, developing an empyema. After the diagnosis of the latter he was transferred to the Surgical Division. There was a family history of tuberculosis.

On March 3, 1919, a fairly large piece of the seventh rib was resected in the axillary line. The pleural cavity was filled with fibrinous coagulations; after thorough evacuation, the lung was found totally contracted near the spine, with a large bronchial fistula visible. In spite of this, Dakin's treatment was carried out and well borne by the patient, although at times he coughed up the solution. After a few weeks his condition was good; the fever had disappeared; but the usual blowing of the James' bottles naturally did not bring any further improvement. One could hear the air blown out of the fistula. To the speaker's mind only two procedures could now come into consideration—either extra-pleural thoracoplasty (multiple resection of ribs) in order to collapse the cavity, with a rather doubtful prognosis as to ultimately closing of it. Besides such a procedure probably would have caused prolonged suppuration which, in view of the tuberculous history, was considered undesirable. The other alternative was the typical Schede operation which would bring the skin to the surface of the lung. The latter operation was decided on and carried out on May 5, under regional and local anæsthesia.

After raising the flap and a long intercostal incision having been made allowing the introduction of the hand in order to find the outlines of the cavity, the tenth to fourth ribs were resected posteriorly and the intercostal bundle of arteries ligated en masse with the other tissues above the bed of the fourth rib, representing the upper border of the cavity, was incised and followed anteriorly; at the latter place the advice of Bier was then followed and the entire chest-wall, ribs and soft parts sewed through under the guidance of the surgeon's eyes with fingers inside, which greatly expedited the operation. In this way the lung was entirely exposed and care taken to remove projecting ribs in order to have the skin fall in easily. The bronchial fistula was clearly seen, but it could not be dissected and eventually ligated, on account of

the patient's poor general condition. In using the scapula to cover the defect, it was placed in such a way that the bronchial fistula remained uncovered. The skin flap was stitched in place with a few interrupted sutures.

After the first stormy days the patient made a good recovery. He was instructed to use the arm as much as possible, so that good function might result. The wound healed kindly, but a fistula on the inner side of the scapula remained. The X-ray showed a long stretched-out cavity, of hour-glass shape, with a very small intermediate canal. The patient being a chauffeur and in service, a radical operation was not considered, but the wound arranged in such a way that the space behind the scapula could be left for gradual cicatrization. Still, the bronchial fistula continued, producing an abscess in front within the axillary incision. At this time the use of the Kromeyer lamp was started with the help of an especially constructed Quartz sound. This allowed the rays to enter the real depth, and under several weeks' careful treatment with additional antituberculous therapy, the wounds closed completely.

It is principally to show the salubrious effect of these rays also in complicated cases with deep-seated fistula that the speaker presents this patient. After a recent severe coughing spell the wound reopened and discharged for a few days, but local treatment promptly effected its closure. To-day the patient is in perfect condition and has the full use of his arm.

DR. HOWARD LILIENTHAL thought that if he had been treating this patient he would have tried to disinfect the cavity with Dakin's solution by the Carrel method and later on would have allowed the wound to close. He believed the bronchial fistula would have closed spontaneously in these circumstances. He doubted that the Kromeyer lamp had caused it to close. He did know, however, that among his cases of lung resection only one bronchial fistula remained open; even that closed temporarily with pneumothorax and was only kept open by the patient after several refillings of the cavity. It was a case of subtotal pneumectomy. All the others had remained closed and that was a more severe test than empyema. One of his cases showed now, four years after lobectomy of the upper lobe, a large pneumothorax, perfectly aseptic, and in that case the patient went through typhoid fever without accident. The patient is perfectly well. Collapse operations of some sort might be necessary in cases of tuberculous empyema.

DR. A. V. MOSCHCOWITZ said that it always gave him pleasure to see a cured case of chronic empyema. In the present instance, however, it did not appear to him that so extensive an operation as the Schede operation is, was indicated. If he had to treat this case he would have persisted in the use of Dakin's solution until the cavity became sterile, and this he would have done in spite of the presence of pulmonary fistula. When the cavity had become sterile, as proven by repeated cultural examinations, he would have allowed the outer opening to close. Doctor Moschcowitz said that he has had good results in so many cases that he now looks upon this method as

## RESECTION OF RECTUM FOR CARCINOMA—COMBINED OPERATION

the standard method of treatment. A very important point in this case that Doctor Meyer mentioned was the existence of a strong tuberculous element, and it is well known that these cases are unusually difficult to cure.

DOCTOR MEYER, in closing, said he had called this a subacute empyema because the patient had had an empyema operation in March and the Schede operation in May, so the condition had become subacute. As to the fistula spoken of by Doctor Lilienthal, there was a large one, but it was in the depth of the empyemal cavity which would have remained a cavity. So it was clearly indicated that inasmuch as the lung would not come to the chest wall, to bring the chest wall to the lung. He considered this patient a case in which there was an empyema with a tuberculous tendency. Looking back after three years he still believed that a radical operation had been clearly indicated. There was one thing which he had seen in a number of these extensive chest-wall operations. This patient, too, remained in a seemingly profound collapse in spite of intravenous and subcutaneous stimulation. He was then placed under oxygen plus pressure for almost twenty hours, which steadied the mediastinum and gave the heart time to adapt itself to the new anatomical conditions.

## RESECTION OF RECTUM FOR CARCINOMA—COMBINED OPERATION

DOCTOR MEYER presented a woman thirty-four years of age, married and the mother of several children, who had been operated upon six months before for hemorrhoids by another surgeon. She continued to lose weight and symptoms pointed to the presence of a tumor, which was found by the rectoscope, its lower border being about three inches above the anus.

On May 5, 1921, Doctor Meyer performed a combined operation under general anæsthesia. Left rectus incision; liver not involved; the tumor was palpable low in Douglas' pouch, its seat being at the fornix of the vagina, very tightly adherent. Double ligation and division of inferior mesenteric artery, just below the exit of the left colonic artery. High Trendelenburg posture; incision of peritoneum at outer border of descending colon and sigmoid down into Douglas' pouch; exposure of tumor difficult on account of the depth and the adhesions of the tumor; sacral cavity entered and rectum loosened from above, bluntly, as far as possible, separating it from the cervix and vagina. Introduction of a sterile tampon on either side of the rectum; layer closure of abdominal wound; transfer on apparatus which allowed knee-elbow posture. Typical Kraske operation, resecting the lower end of the sacrum with the coccyx. After division of the pelvic fascia, the gauze tampons on either side are easily reached, greatly facilitating the further work. After ligation of middle and inferior hemorrhoidal arteries, the sigmoid can be pulled down a considerable distance. Closure of Douglas' pouch, attaching it by suture to the sigmoid; one cigarette drain to peritoneal cavity. After careful tamponade of the entire wound, the sigmoid is doubly clamped and divided with the cautery two inches above the tumor; temporary closure of proximal stump with a continuous mattress suture

of silk and additional inversion with interrupted mattress sutures, the threads of which were left long; double clamping and division of rectum one and a half inches above anus, which means removal of the tumor-bearing intestinal loop; distal end cauterized. After lysol cleansing, the rectal stump is everted and the mucosa excised; after re-inversion, the sigmoid is pulled through the anus, which had been slightly stretched, projecting about two inches. The closed stump is then fastened to the skin with a few silkworm-gut sutures. The wound closed with drainage; a permanent catheter was placed in the bladder. Patient stood the operation well. After normal pulse and temperature for two days, the latter began to rise. Sixty hours later, first change of dressing with the intention of amputating the projecting portion of the intestine. On lifting patient to the operating table a discharge with audible gas report took place. It was found that the projecting portion was flabby and gangrenous, probably in consequence of the constriction by the but gently stretched anal ring. The immediate consequence of this gangrene of the projecting portion of the gut was a continuation of the same on to the pelvic fascia, which greatly interfered with the after-treatment.

The most interesting point, which particularly prompted the speaker to present the case, was the paresis of the bladder, which long refused to yield to all treatment. It was no easy matter to convince the patient that spontaneous micturition would surely return—a hope which could be rightly entertained, as the phenomenon had been seen repeatedly after resection of the rectum for carcinoma, the function, however, always returning. In this case it took fourteen weeks, when at last spontaneous micturition reappeared. After a few weeks the patient was sent to the country where she spent the greater part of last winter. To-day she has gained over sixty pounds in weight and has full control of her stool. With the examining finger in the rectum, a distinct voluntary contraction of the sphincteric ring can be noticed. A small sinus still leads into the sacral cavity, which, however, gives all promise of closing in a very short time.

In former operations the speaker had always sacrificed the entire lower portion of the rectum inclusive of the sphincter—with one exception which also had given a favorable result with regard to control—the proximal stump being fixed, according to its length, close to the sacrum (sacral anus) or as low down to its normal position as possible, in order to enable the patient to have the normal procedure in defecation; of course reliable control could not be rendered.

After this experience the speaker inclines to try oftener the preservation of the lowest portion of the rectum; the great advantages to the patient are apparent. He is also inclined to do the combined operation in one sitting and feels that he cannot place too much emphasis on the excellent result of primary ligation of the inferior mesenteric artery from above with regard to mobilizing the sigmoid flexure.

The pathologic report in this case was: Adenocarcinoma. Inasmuch as great care was taken to remove all visible glands from above, the hope exists

that the patient may enjoy the result of the operation for some time to come. A further report will be given after the lapse of a few years.

DR. WILLIAM C. LUSK said that yesterday he had examined a patient (male), now thirty-nine years of age, whose rectum he had resected for adenocarcinoma nearly twelve years ago. There was no recurrence. The inferior hemorrhoidal nerves had been preserved intact and the sphincters had always functionated normally, and there had not been the slightest stricture resulting from the operation. The patient had been shown before this society in October, 1910 (*ANNALS OF SURGERY*, 1910, pp. 836 and 855). The tumor had been situated in the anterior rectal wall, its lower margin lying from one and a half to two inches above the upper margin of the internal sphincter. The operation was done by the combined routes in two stages, the first stage almost entirely under spinal anæsthesia, and the second stage on the following day under ether narcosis, at which latter the resection was performed, the anastomosis having been effected between the descending sigmoid and the distal segment, section having been made an inch below the tumor, by circular (interrupted) suture done within the posterior wound above the sphincters. The value of two principles applied in this resection would seem to have been substantiated by the result, namely, first, that the upper division of the bowel be made through the lower sigmoid so that the proximal segment in the anastomosis should be completely covered with peritoneum (there was a large marginal artery in this patient at the site of section of the sigmoid), and, second, that the mucous edges of the suture line be brought together in very accurate alignment. In this case the latter object was accomplished, by inserting holding sutures through the mucous edges (including the serous edge of the proximal segment) at intervals, catching up opposite points of the bowel ends to be united, so that when any two adjoining holding sutures were pulled apart, they would hold the mucous edges in even apposition, while deeply placed stitches, including about half an inch of either margin, were passed and tied. A very helpful practice in performing this anastomosis, learned from Kraske, was the placing of holding loops at intervals along the margin of the distal segment of gut, as the latter became severed by interrupted cuttings below the tumor, for the subsequent control of this edge in suturing.

In comparing circular suture of the bowel ends done through the posterior wound above the sphincters, with suture of the ends after their invagination through the anal canal, he regarded that the former method had all the advantages. With the former technic it required the descent of from five and a half to six inches of the freed sigmoid extremity into the pelvic cavity below the level of the left common iliac artery to effect the anastomosis above the sphincters without tension, while with the latter technic the freed sigmoid extremity would have to be capable of a descent sufficient to enable it to pass through, and protrude from, the anal canal, an attainment anatomically often impossible, and one attended with increased liability of the occurrence of sloughing. As regarded the distal segment, when circular suture above the

sphincters was done, this piece of bowel, remaining fixed to the soft parts, retained its nourishment and maintained the suture line in relation to peripheral tissues with which supporting adhesions might form, while with the invagination technic, a sufficient length of rectal wall above the internal sphincter was needed for the formation of a cuff to invert through the anal canal, which when reduced above the sphincters after the anastomosis had been made, having no mural support, would, together with the seat of the anastomosis, lie collapsed in a way to encourage stricture formation. The question of the viability of the rectal cuff, dissected from its peripheral vascular connections and with its blood supply from the superior and middle hemorrhoidal arteries cut off, should also be taken into consideration.

MASSIVE COLLAPSE OF THE LUNG

DR. FORDYCE B. ST. JOHN read a paper with the above title.





FIG. 1.—Securing a large skin graft. (Dorrance.)

798<sup>6</sup>



## CORRESPONDENCE

### SECURING LARGE SKIN GRAFTS

EDITOR ANNALS OF SURGERY:

SIR:

IN the ANNALS OF SURGERY of March, 1920, I gave the method I was employing in placing a skin graft in the oral cavity, and made the statement that I never failed to obtain a graft. Since the publication of this article, I have received numerous requests as to the method of obtaining these large grafts. A research of the literature on the technic of skin grafting made several years ago proved disappointing in many respects. The type of cutting instrument used seemed to be the most important factor in the minds of most authors. As a matter of fact, any razor or amputating knife will answer our purpose, if the following rules are observed.

1. Use the blocks suggested by Halsted to obtain longitudinal tension and the broad, flat surface.

2. Have the assistant place his hands under the arm or thigh from which the graft is to be taken, and by grasping the skin firmly, obtain a strong lateral or transverse tension.

3. Use salt solution or vaseline to anoint the area from which the graft is to be taken.

4. After the graft is started, do not pause, but keep up a continuous lateral or to-and-fro motion until the desired length is obtained.

The most important factor, to my mind, is the immobility obtained of the lateral fixation of the skin by the assistant's hands.

The method is not original, but I am unable to locate the article in which it was first suggested. The cut shows the method better than words could.

GEORGE M. DORRANCE, M.D.,

*Philadelphia, Pa.*

### PRESSURE AS A FACTOR IN SKIN GRAFTING

EDITOR ANNALS OF SURGERY:

SIR:

Many different methods of applying the various types of skin grafts have been used with varying success. Some have urged the importance of a bacteria-free surface before placing grafts and attribute the success of the operation to careful field preparation. Others graft unhealed areas without giving much thought to the state of infection. It is generally the opinion that the surface to be grafted should be reasonably free from active infection, but not necessarily rendered sterile as shown by culture. In this operation it is well to remember that all bacteria on skin and wound surfaces are not virulent and may not inhibit the growth of grafts.

Regardless of the condition of the graft and the grafted area, the former must be held in place in such a way that the granulation tissue may grow into the grafts. To accomplish this the contact must be snug. Grafts that are floated loose from the surface by pus, blood or serum have no chance to receive a blood supply from the healing area and become viable.

It has been definitely shown that adhesive strapping is of value in the stimulation of epithelial growth in ulcerated areas. What the factor is in its use is not quite clear. It may act only as a bridge along which the epithelium creeps, or, as pointed out by Dr. E. D. Twyman,<sup>1</sup> may by its pressure restrain the growth of excessive granulations and not interfere with epithelial progress. He states that "epithelium proliferates readily when subject to a degree of pressure which restrains the growth of granulation tissue." If this is true, it would apply in the case of skin grafting. Adhesive strapping fixes the graft firmly to the grafted surface, holds it from slipping and furnishes an opportunity for capillary attachment or "taking." In addition it prevents the upgrowth of excessive granulations which is a hindrance to healing both to the new grafts and the edges of the ulcerated or denuded area.

For several years I have fixed skin grafts in place on the grafted surface by simple strapping with strips of zinc oxide adhesive as used by Vosburgh.<sup>2</sup> After all grafts are in place strips of adhesive, two or three cm. wide, are flamed and drawn snugly across the area. Pressure enough is used to firmly hold the grafts to the surface, thus squeezing out any blood or serum that may have collected beneath. The pressure should not be great enough to blanch the surrounding skin and disturb circulation. The straps are narrow enough to afford drainage of the areas between them, and are placed closely enough together so that all parts of the graft are held firmly down.

At the end of ten days the adhesive is removed without disturbing the grafts if they have grown in place. If they have not become attached in that time, they are a failure. During the ten days, if the discharge from the wound is too profuse, the dressings may be changed down to the adhesive as frequently as necessary. There is no opportunity for the granulations to become excessive and attach themselves to the adhesive. It is unlike gauze and other meshed material in that it prevents granulations from growing upward through the dressing and thus hindering epithelialization. In addition there is no trauma when the adhesive is removed as there may be with the gauze dressing. The adhesive is always free at the expiration of ten days.

The adhesive strapping method is applicable to any type of graft. If the graft is large it is wise to snip openings in it to avoid the collection of pus or serum beneath.

It seems quite definite that pressure serves a double purpose in skin grafting; it holds the grafts firmly in place against the unhealed area and stimulates



FIG. 1.—Skin grafts strapped down with strips of zinc oxide adhesive.

880<sup>a</sup> -



rapid epithelialization by preventing excessive granulations. If adhesive strapping promotes rapid growth of epithelium at the edge of an ulcer, it is quite reasonable to believe that grafts may be stimulated to more rapid growth in the same way. The method is simple and seldom fails when autografts are used.

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### DRAINAGE IN BLADDER CANCER

EDITOR ANNALS OF SURGERY:

SIR:

The difficulties of permanent drainage of the bladder in inoperable or recurrent carcinomata of the bladder and prostate gland is evident to all who have had charge of these unfortunate patients. If the drainage tube is small, it is likely to become plugged with blood clots, while on the other hand if it is large it is unwieldy and produces more or less discomfort.

During the past two years we have modified the method of dealing with these patients and the results have been quite satisfactory. Our plan is as follows: The bladder wall is sutured to the abdominal wall and a tube  $\frac{1}{3}$  to  $\frac{1}{2}$  inch in diameter is inserted. Suture of the bladder to the abdominal wall is not necessary but facilitates, subsequently, the introduction of the tube. The incision is closed in the usual manner and the tube is cut off so as to project about  $\frac{1}{4}$  inch above the skin. A very large safety pin is then passed through the outer part of the tube. A strip of sterile adhesive plaster with a hole in it is carried over the end of the tube and safety pin in such a manner as to hold the tube in place. Sterile vaseline or zinc oxide ointment is smeared around the area of the incision. Then a large colostomy ring with a rubber sleeve over it ( see Fig. 1) is placed so that the ring does not press on the incision. The strap is adjusted around the back and tightened until comfortable.

The urine is carried through a tube into a bottle by the bedside.

Moving this tube or traction on it does not cause any discomfort because it is attached to the belt rather than to the tube in the bladder. All of the tubes are large and allow the passage of clots.

The device may be removed from time to time as indicated (2 to 7 days) and the tube in the bladder removed, cleaned and boiled. Dakin's solution, argyrol or other medicament may be injected, as indicated, through the outer tube or through a catheter passed into the bladder.

If desired radium at times, may be applied through the incision as the opening is kept rather large.

Surprisingly little trouble is experienced in the management of malignant growths of the bladder or prostate by the plan above outlined; in fact, a nurse or orderly or a member of the patient's family can make the changes when necessary.

It is not suitable for patients who are very thin and whose symphysis projects so as to prevent a smooth seating for the ring or large colostomy device.

The tube may be disconnected when the patient is up and the cock drained from time to time as the urine accumulates.

The patient is kept dry when he is on his back, propped up in bed, is in a wheel chair or is walking around, but it is likely to leak when he lies on his side.

EDGAR G. BALLENGER, M.D.  
*Atlanta, Ga.*

### GONOCOCCUS IN ARM ABSCESS

EDITOR ANNALS OF SURGERY:

SIR:

The following case is reported because the appearance of the gonococcus in an ordinary abscess or sinus has been very rarely, if ever, recorded in the literature. A white woman, age twenty-two years, married seventeen months, presented herself on February 24, 1921, with a sore on her right arm, which "will not heal."

On February 1, 1921, a pimple appeared on the right upper arm. By the day following, the arm had become swollen, quite red, exquisitely tender and painful. The woman then applied to a certain genito-urinary specialist, who stuck a needle into her arm and then opened the pimple with a knife. This doctor visited the woman twice at her home and dressed the wound. The inflammation, however, spread; the pain was unrelieved, the wound continued to discharge pus and the surrounding tissues burned and itched. The woman was first seen by me February 24, 1921. She was robust and well nourished. The temperature was normal. With the exception of the lesion described below, the physical examination was absolutely unproductive. The sore was on a line with the posterior border of the deltoid muscle and some 2 cm. below its insertion. It was 1.5 cm. in diameter and 0.5 cm. in depth. The edges were fairly regular, slightly undermined, and had a punched-out appearance. The base was covered with a purulent exudate which, on removal, revealed a healthy red color, as of muscular tissue somewhat thrown up into papular nodules. At its upper and posterior margin was seen a small circular opening about the size of the shaft of a large pin. Pus was squeezed from this orifice and a platinum wire was introduced into a sinus



to the depth of 1 cm., without causing pain. The exudate was creamy white, odorless, and of small amount. The abscessed area was surrounded by a red halo. The blush measured 0.5 cm. across. The tissues beyond looked and felt normal. The epitrochlear, axillary and cervical lymph-nodes were not palpable. When the two arms were compared, no difference in size was apparent. Stained smears showed polymorphonuclear pus cells, a few mononuclear cells and gram-negative intra- and extracellular diplococci. The lesion was washed with alcohol and a dry dressing applied. On February 25, 1921, a new series of smears were made with the same results. On this date some of the pus was planted on plain agar and a liberal portion smeared on blood serum agar. One set of cultures was cotton stoppered, the other oxygen reduced. No growth resulted. On February 26, 1921, smears and cultures were again made and forwarded to Dr. Percy D. Meader, bacteriologist, The Johns Hopkins University, School of Hygiene and Public Health, whose report is as follows:

"Microscopical examination of this discharge disclosed almost a pure culture of a gram-negative bean-shaped diplococcus, but was not intracellular. Although the discharge had been away from the patient for some time an attempt was made to grow the organism on suitable media, but a diphtheroid which was the only other organism present in the smear preparations was the only organism cultivated. This rather confirms the microscopical examination since the gonococcus fails to grow unless planted almost immediately after the discharge is obtained from the patient.

"A test for the presence of gonococcus protein in the discharge was made by the method recently published by Dr. G. H. Robinson and myself. This test was strongly positive. In a series of nearly 1000 examinations we have yet to find the precipitin test giving a false reaction.

"The result of these examinations indicates conclusively that the sample of discharge given to me contained the gonococcus.

On February 28, 1921, smears and cultures gave the same results as before. The precipitin test was again positive. On March 1, 1921, smears were submitted to Dr. Howard J. Maldeis, visiting pathologist, University Hospital, who confirmed the previous findings. As the sinus had up till now proved refractory, it was irrigated with protargol, and nitrate of silver applied. On March 3, 1921, the patient was seen by Dr. Alexius McGlannan, Professor of Surgery, in the University of Maryland. Cultures and smears were again made and a blood culture taken. Smears on this date showed gram-negative intra- and extracellular diplococci, apparently swollen and associated in chains of four to six organisms. The wound was washed off with ether, burnt with silver nitrate, and dry gauze applied. The sinus had disappeared and the exudate was very scant. The cultures made this date again failed to yield a growth, but the blood culture showed a streptococcus hæmolyticus. March 6, 1921, the wound had entirely healed, leaving behind

## CORRESPONDENCE

as a relic an indurated scar about one cm. thick. A blood culture made this date was negative.

This case is very interesting in that the gonococcus was recovered from an abscess in an arm of a patient who previous to her visit to a surgeon for treatment of a furuncle, had never been exposed directly or indirectly to the Neisser infection, and who did not have, nor had ever had, gonorrhœa. It demonstrates conclusively the gonococcus that may cause an abscess of the soft tissues. In this instance the infection was undoubtedly inaugurated by the knife of the specialist in venereal diseases who first treated the patient. So far as I am aware, the case is unique in the medical annals as a most thorough search of the literature has failed to reveal anything like it.

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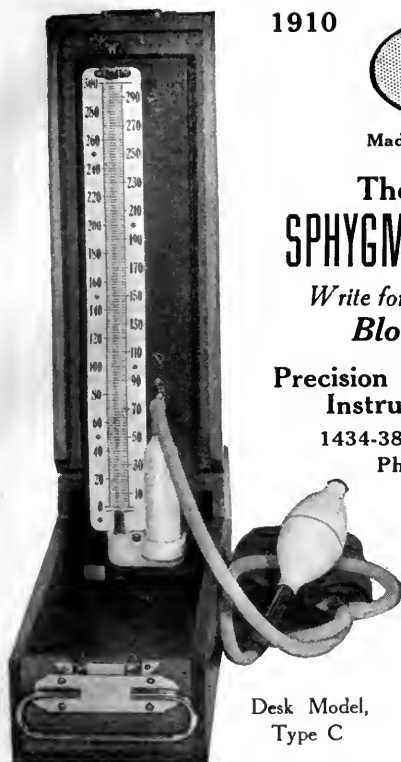
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